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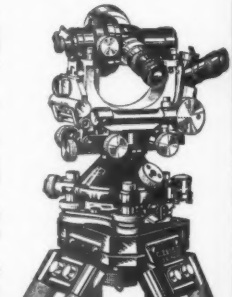

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The
GEOGRAPHICAL JOURNAL

Vol LXXIV No 6 R.G.S. *December 1929*

THE SEARCH FOR COLONEL FAWCETT: *A paper read in part at the Special Evening Meeting of the Society on 22 April 1929, by*

G. M. DYOTT

THE State of Matto Grosso, in Central Brazil, is usually pictured as a vast expanse of impenetrable forest interspersed with fever-ridden swamps where everything injurious to white men exists. Such a conception is entirely false. In reality it is open healthy country as different as possible from the low-lying ground of the Amazon. A great many travellers are familiar with the southern part of the state, which falls within the watershed of the Paraguay, and can visualize the scenery, but our mental picture of the country to the northward is not so clear; in fact, it fades away to the merest shadow when we contemplate the southern fringe of the Amazon basin. I know of no part of South America about which so little authentic information is available as this Central Plateau. Fact and fable are so interwoven that it is impossible to say where one begins and the other ends. Whichever way one turns one is confronted with such fantastic legends as gave rise to Conan Doyle's famous story of the Lost World. The simple country folk believe in these implicitly. They tell of fabulously rich gold-mines, and of walled cities in the jungle where dwell a civilized people who have lost all contact with the outside world. Then there are strange tales of flashing lights that never grow dim which have been seen in the open windows of ancient stone houses, and reports of fair Indians presided over by women warriors. Why this part of the globe should have more than its share of fable is difficult to say; but the fact remains that it has, and even the most sceptical eventually finds himself admitting that there must be some element of truth in all that he hears.

Colonel Fawcett made exhaustive studies of these legends and saw in them the answer to the riddle of Lost Atlantis. With the object of proving his theories he set out in 1925, accompanied by his son Jack and a young friend Raleigh Rimell, confident that he was on the eve of making momentous discoveries that would startle the whole world. His plan of campaign was shrouded in mystery, and the greatest secrecy was maintained throughout, as he was not anxious for others to follow in his footsteps. The story of his complete disappearance, followed by rumours of his being seen living on a farm, are all well known (see *Geogr. Journ.*, 71, 176; February 1928). Suffice it to

say that I was asked to go and look for him, and to ascertain the true facts of the case as far as it was possible to do so. After considerable difficulty I managed to get a small party together, and set out for Brazil in February of last year. I was absent for the best part of eight months, and my experiences during that time are set out in what follows.

It should be stated at the outset that this expedition was not organized to explore Brazil but to hunt for Colonel Fawcett wherever he might be. Whither his trail would lead us we knew not. The uncertainty about our movements added, no doubt, to the zest of our undertaking, but complicated matters considerably, and was not very satisfactory to any one of a methodical turn of mind.

The expedition was not equipped to make any observations of position, our only instruments being prismatic compasses. Some comment was made at the start with regard to my carrying motion-picture cameras and wireless apparatus to the exclusion of survey instruments; but it must be remembered that my personal resources were stretched to the limit as it was, and did not enable me to shoulder the entire expense of the enterprise. I was obliged to fall back on such assistance as I could obtain through contacts with the newspaper organizations; and my primary obligation was, therefore, to cater for the popular aspects of the search. As might be expected, nothing was left over for map making and other scientific work which I would have liked to have undertaken. In spite of this handicap I gathered many facts about the country we covered. My observations are more or less influenced by previous expeditions, particularly the one I made down the River of Doubt in 1926–27. When I made this latter trip the rains were at their worst, whereas the Fawcett search was conducted during the rainless season. Having covered similar ground at the two seasons of the year, I am able to arrive at a better appreciation of its character than would otherwise be the case.

No one in Brazil is better informed on the State of Matto Grosso than General Candido Rondon, who organized and conducted Colonel Roosevelt's famous expedition in 1913–14. The friendly relations which have existed between the General and myself have helped me on various occasions, and I must again express my sincere thanks for all he did on my behalf on this last venture. I have also to mention Dr. José Bezerra Cavalcanti, chief of the Indian Service, who placed some of his staff in Cuyabá at my disposal. It is a pleasure to record the welcome my party received on all sides, and we came home with a warm feeling for Brazil and the Brazilians in our hearts.

Colonel Fawcett was a man of indomitable will, infinite resource, fearless of danger, and with a decided leaning toward mysticism. A veteran explorer in tropical jungles, he had a score of expeditions to his credit in South America. For many years he had been filled with the idea of finding a lost civilization. He was not a believer in big expeditions with many mouths to feed and much baggage to cart through the wilderness. He pinned his faith to making friends with the jungle folk and persuading them to assist him as he went along. With this idea he planned his venture into what is generally called the Xingu, a vast area embracing 50,000 square miles of territory. He cut down his supplies and provisions to the limit and discarded every ounce of surplus stores from his equipment.

The outcome of a venture conducted on such lines into a country known to be hostile was dubious. Some agreed with the Colonel's views; others had no sympathy with his methods and termed his policy suicidal. It did not cause surprise when news of his progress ceased to filter through, a couple of weeks after he had passed into the blue horizon north of Bakari Post. Weeks ran into months and even years passed without serious apprehension being felt, since Fawcett had declared that he might settle down with some Indian tribe for a couple of years, if it suited his purposes. It was only after three years had elapsed that people became really anxious, and I was asked to lead an expedition of inquiry.

After many delays my party of five embarked on February 19 for South America on the SS. *Voltaire* of the Lamport and Holt Line. None of my companions had previous experience in the field of exploration, their knowledge lying in other directions. William De Mello and Gerrard Martin were both wireless experts; J. J. Whitehead and Samuel K. Martin made up the photographic staff.

How we got to Bakari is quite a story in itself. Unexpected developments necessitated a longer stay in Rio than we had anticipated, but on 6 May 1928 we were in Cuyabá, the seat of the local government in the State of Matto Grosso. Without delay we proceeded in motor trucks to the mission station of Buriti, where we were cordially received by Mr. Martin, the director. Buriti was at one time a thriving *fazenda*, but it had fallen on evil days and was almost forgotten when it was taken over by the missionaries who are the present owners. It is about 28 miles to the north-east of Cuyabá, on the very rim of the highland country, at an elevation of nearly 2000 feet. The nights are decidedly chilly. Plenty of blankets are essential to any one who wants to sleep comfortably.

Our first step was to unpack our large crates of equipment and rearrange them in suitable bundles for bullock transport. We also took advantage of the opportunity to test out our wireless equipment. The results were most satisfactory, with the one exception of the motors which were to have been used for operating our large transmitter and charging batteries. To our horror we found that such essential parts as piston rings were missing. After endless labour we made these, but other parts showed defective material and workmanship, causing further trouble and anxiety. It reflects greatly to the credit of both De Mello and Gerrard Martin that they were able to achieve the results they did under the severe handicap imposed upon them at the start. In consequence of this motor trouble all communication had to be carried out through the small $7\frac{1}{2}$-watt set built by the Silver Marshall Company of Chicago. The larger set constructed by Cardwell never got a fair chance to demonstrate its worth. We worked with wave-lengths of 20 or 36 metres, depending upon the atmospheric conditions and the time of day. Wireless played an important role in our activities, and we were in communication with the United States of America most of the time.

The hand of civilization spreads lightly over the State of Matto Grosso. At the extreme tip of one finger a group of shacks is to be found clustering dejectedly about a flagpole. This is Bakari or Simoēs Lopez Post, as it is more generally called, the base from which the government hopes to develop the

unknown lands which stretch away for countless miles to the Amazon watershed. It took Fawcett a whole month to get here from Cuyabá. We made the trip in six days by cutting across country and travelling in motor trucks for the greater part of the distance. The Government had sent ahead word of our coming. Consequently when our cars deposited us bag and baggage on the banks of the São Manoel river we found an army of pack-animals assembled ready to carry us to Bakari and beyond. It would have been impossible for us to have collected animals in such numbers at short notice. For several weeks they had been assembling in anticipation of our arrival. By twos and threes they had come from outlying districts in response to the Government appeal. Some had covered 100 miles or more, travelling in easy stages of 15 or 20 miles a day.

The direction we took by car after leaving Buriti was almost due east, and 35 miles or more along the modern road which connects Cuyabá and Tres Lagoas. We passed the small settlement of Chapada on the way. It was just beyond this place that the Frenchman, M. Courteville, said he had met and spoken to Fawcett. As many cars are passing daily along this well-worn and well-used highway, it is obvious that Colonel Fawcett could never have been in the district without his presence being known to many. The story of this meeting as it appeared in the newspapers over M. Courteville's signature has a slight embellishment that is worth mentioning. He spoke of mosquitos feeding on the bare legs of the person he met. Curiously enough, there is not a single mosquito to be seen in this district at any time of the year.

Beyond the village of Chapada we left the roadway and turned almost north-east, following the high ground which marks the watershed between the Paraguay and the Amazon. This is all open country devoid of forest. In some places there was not even scrub to be seen, or stunted trees, only coarse grass through which the north-east wind blew vigorously. Our running time by car from Cuyabá to Buriti was three hours. From Buriti to the São Manoel it was nine hours. The total distance was roughly 330 kilometres. The first stage of the journey to Buriti and Chapada was through rather hilly country and over a bad road. On reaching the top of the plateau at Chapada our way led across easy rolling country in many respects like certain parts of the African veldt. The rock between Cuyabá and Buriti was for the most part friable sandstone lying almost horizontally, with a few intrusions of white quartz near Cuyabá.

Before leaving Cuyabá I hired five *camaradas*, or native helpers, to go with us all the way to Pará. They were of the usual rough serviceable type of men accustomed to the hard life of the wilderness. A man called João Climaco and two other camaradas, were also put at my disposal by the Government. These three men were to return when the going became too difficult for large numbers, or they were to carry on with me to the end, whichever I thought best when the time came to make a decision.

We were fortunate in being able to go as far as we did by car. With the usual animal transport it would have taken us at least ten days to reach the São Manoel, and to have travelled thus through such monotonous country would have been fatiguing in the extreme. When we first abandoned our fast-moving cars in favour of the mule and bullock it seemed as though we should never get anywhere at all. On leaving the banks of the São Manoel our course veered

High escarpment on the plateau rim near Buriti

Isolated plateau such as gave rise to the story of the Lost World

220-foot waterfall on the plateau: exit below by a narrow gorge

around to the north. There were many detours east and west to avoid streams and other obstacles, but rough observations taken as we advanced from ridge to ridge showed that we were making a northerly direction all the time. We forded many streams, all affluents of the Paranatinga. We also crossed by canoe the Paranatinga itself, a river of considerable size. The baggage was ferried over and the pack-animals had to swim. In the rainy season the São Manoel and other small creeks would be impassable.

Four days' ride brought us to Bakari, a dismal spot. Like most outposts of so-called civilization it is not attractive from any angle. It is planted on top of some rising ground with the nearest water almost a mile away: not a shrub, not even a blade of grass; only a few ramshackle huts enclosed within barbed wire fences, as a precaution against Indians. We took on additional supplies of rice and farinha at Bakari, and extra pack-animals had to be provided to handle it. When we left, our caravan reached a total of sixty-four bullocks, ten mules, and twenty-six men. In addition to our *camaradas* we took on five Bakari Indians from the post, who had been doing some advance scouting on our behalf along Colonel Fawcett's track of 1925.

We set out in four groups, each half a day's march behind the other. To have travelled as a single unit would have been almost out of the question, as pasturage on the central plateau is never plentiful during the dry season. I doubt if it would have been possible to find places where so many beasts could graze together. The bulk of our cargo was food, and plenty of it. One cannot enter this country without it. Game is not to be depended upon, and such as we kills can only be regarded as so much extra. We were therefore well loaded with sacks of rice, beans, farinha, dried meat, coffee, sugar, and salt, on which we subsisted during the entire journey. Cameras, motion-picture cameras, tripods, two wireless sets, batteries, generators, and innumerable cases of oil and gasoline, added greatly to the difficulties of transport. We had in all nearly three tons of baggage to lug about, every ounce of which was essential if we were to carry out our programme.

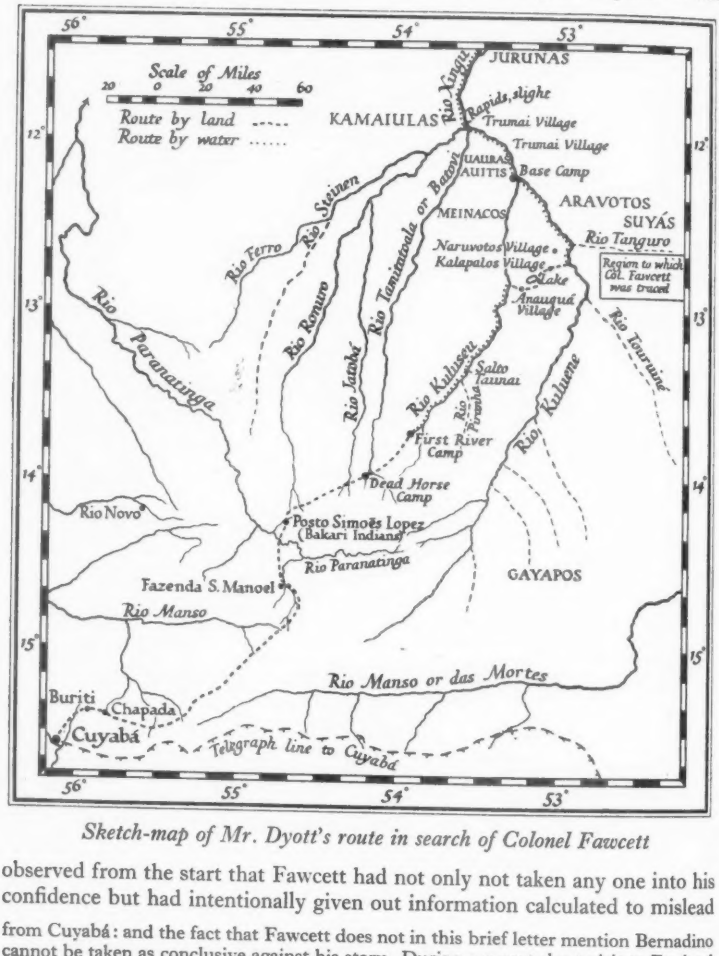
Colonel Fawcett left Bakari on 21 May 1925, and nine days later sent back letters from a place he called Dead Horse Camp. This was the last authentic news from him. It did not help us much, because no one knew certainly where Dead Horse Camp was, as its geographical position as given by Fawcett differed in different letters.* When writing to the Royal Geographical Society he had disclosed his plans to the extent of saying that on reaching Bakari he would strike north to the Paranatinga and at a given point turn east toward the Xingu. When we came to scout along his trail we found that it turned off to the north-east and then took an entirely different direction. By a stroke of good luck we fell in with a Bakari Indian called Bernadino† who had accom-

*The position of Dead Horse Camp has been discussed in *Geogr. Jour.*, 71, 178, February 1928; and in 73, 540, June 1929. It has since been noticed that in his last report to the North American Newspaper Alliance from that camp he gave the latitude as 13° 43′ S.: and the conjecture that in his letter to Mrs. Fawcett he had written 11° for 13° is thus confirmed.—ED. *G.J.*

†In his last letter from Dead Horse Camp (*Geogr. Jour.*, 71, 178, February 1928) Colonel Fawcett wrote: "Our two guides go back from here"; and it has been argued that this is against the credibility of Bernadino, who claimed to have been with Fawcett in 1925 as far as the Kuluseu. The two guides who went back from Bakari Post were

panied Fawcett, and he steered us across country to a stream known as the Kuluseu, down which the Fawcett party had sailed in two canoes. This resulted in saving us a world of trouble and enabled us to get on the scent without much loss of time.

There are no regular trails of any sort in this region—only those made by wandering tapir, or Indian paths that criss-cross the open chapada. It was



Sketch-map of Mr. Dyott's route in search of Colonel Fawcett

observed from the start that Fawcett had not only not taken any one into his confidence but had intentionally given out information calculated to mislead

from Cuyabá: and the fact that Fawcett does not in this brief letter mention Bernadino cannot be taken as conclusive against his story. During a recent short visit to England Mr. Dyott has discussed this and other points, and has authorized the Editor to add to his paper a few footnotes dealing with them. Bernadino belonged to Bakari Post, and was put forward by the Indians there as having been with Fawcett in 1925. He travelled with Mr. Dyott for many days, and was constantly questioned. In Mr. Dyott's opinion there is no reason to doubt his veracity.—Ed. *G.J.*

any one who tried to follow. He had good reason for thinking that others might try to steal a march on him. On one of his earlier journeys a prospector had trailed him in for some considerable distance, and as surely as Fawcett broke camp in the morning this man would be there by nightfall, pitching his tent and waiting for the next move.

The country through which we proceeded with such light hearts was vacant beyond belief. It was open, hard, and rocky; and nothing grew on the hills except coarse grass or a few unfortunate trees twisted all askew in their hard struggle to exist during the six months when no rain falls. In the ravines there are trees of better proportions that mark the watercourses. Along the side of the bigger rivers a belt of forest is usually found. In all this vast sweeping country not a solitary white man lives: there is not even a half-white inhabitant; only Indians live there in the utmost simplicity. A handful of Bakaris cultivate the soil in a crude way and are quite peaceful. Their enemies, the Gayapos, are more numerous. They are hunters and travel far in their quest for game. From the headwaters of the Paranatinga northward for several hundred miles these travelling slingers of clubs may be encountered. It is the Gayapos who prevent settlers entering the region, and chill the blood of the chicken-hearted traveller who skirts the fringes of this zone.

Our party rode through the dismal wilderness hour after hour, roasting by day and frozen stiff at night, when the thermometer would drop from 94° to 50° within a few hours. The camaradas walked barefooted and had no difficulty in keeping pace with our extremely slow rate of travel. In any event they had no desire to lag behind, as they were afraid of the Indians, and did not wish to be picked off by a stray arrow from the bush.

Along the trail there were marks on the trees, fairly frequent and quite distinct to a trained observer. Some may have been three years old; others, more numerous, of recent date.* At one camp site, near a river called Batovi, we were informed that Fawcett's horse had died and that he had sent back some of his men.† This, then, was Dead Horse Camp. We hunted for the bones of animals, but were told that the extraordinary floods the year before had washed everything away. The Batovi proved a difficult river to cross. We had to unload all the animals and carry everything over on our shoulders. The bed of the stream was hard rock, full of holes bored deep in the solid stone by the whirling action of the quartz pebbles, which varied in diameter from one inch to several feet. A bullock stepped into one hole and fell heavily, but without injury. The loss of a single animal would have been a severe handicap to us, as it would have meant abandoning his cargo by the roadside. Ten minutes after fording the Batovi we encountered another river still more difficult to

*The question has naturally been raised, whether these trees were blazed by the Fawcett party, who were anxious to avoid being followed. Mr. Dyott is of opinion that they were not. But the older ones might have been made by the men returning from Dead Horse Camp with the surplus animals. This returning party is said to have carried back with them to Cuyabá a number of instruments which Colonel Fawcett found he could no longer carry, and it is hoped that they may be recovered.—Ed. *G.J.*

†The information came from Bernardino. The horse died in 1920. In 1925 Colonel Fawcett, writing his last letter from this same camp, said: "Only his white bones remain." Bernardino's account must be interpreted as identifying in 1928 the site where he had camped with Fawcett in 1925 and learned that the horse was lost on the previous journey.—Ed. *G.J.*

negotiate. During our six days' march we crossed many small streams and mud-holes. If we had passed this way during the rainy season, beyond all question the rivers would have been too deep for the pack-animals to cross. As it was there were many places where we only just managed to pass.

The wide belt of country which stretches from the Araguaya to the Rio Roosevelt, and is known as the Central Plateau of Brazil, has an average elevation of about 1500 feet above sea; toward its western edge it drops off considerably. In many places there are high escarpments crowned by eminences worn by wind and rain into peculiar shapes which at a distance resemble houses, towers, or even ruined cities. The slanting rays of the sun reflected from some of the polished surfaces might well have given rise to the stories of flashing lights seen in the windows of ancient stone buildings.

Contrary to what one might expect, the central plateau exhibits marked climatic changes as the seasons come and go. In the low-lying Amazon valley the seasons are frequently referred to as the wet and the less wet, whereas on the plateau the difference between the wet and the dry is as pronounced in its way as winter and summer are in our northern latitudes. A valley which in June and July is paved with burning rocks and parched sandy soil, is dripping with moisture in January and February. Water oozes from every crack, and almost every gully has a stream 20 feet deep tearing down it. From June to September and sometimes up to November no drop of rain falls, and the whole country-side is forsaken by man and beast, except where an occasional spring squeezes a few priceless drops of water from a hillside. If provision could be made against drought this should prove marvellous cattle country in the future. I saw vast expanses sweeping away for miles and miles covered with capim grass, which is excellent for feeding stock.

Six days after leaving Bakari we reached the banks of a small stream known as the Arame, a branch of the Kuluseu. It is a small river, and the high banks are lined with a wide belt of vegetation. Beyond this spreads the usual arid country such as we had been passing through ever since we left Cuyabá. [According to Bernardino] Fawcett did not take to the water here, although we did. He rode on some distance parallel to the river until he found two bark canoes which belonged to some visiting Indians. He borrowed these and proceeded downstream to the malocas of the Anauquá Indians.

The weeks which followed baffle description. In our conflict with the Kuluseu river we fought our way, mile by mile, down its twisting, spragbestrewn channel. Constant and careful watch had to be kept on the water ahead for fear of running our canvas boats on some submerged log that lay wickedly beneath the surface without so much as a ripple to mark its position. On the straight stretches the bed of the stream bristled with driftwood and old tree-stumps caught in the shifting sands, while on the bends intricate tangles of sticks were crowded up into grotesque heaps resembling giant porcupines. In many places huge trees had fallen astride the stream, forming barricades of branches and roots that stretched from shore to shore like dams. The only way to pass these was to hack a passage through with knife and axe.

As the river grew larger we hoped that navigation would become correspondingly easier, but that proved a mistake; conditions became steadily worse and rapids more numerous than ever. In one place we floundered about

in the racing waters like so many walruses for five days in succession. The narrow channel spread out so sparingly over a wide expanse of rocks that we were obliged to get out and walk, leading our canoes, pulling them here, pushing them there, avoiding jagged ledges, and sometimes carrying the heavy cargoes on our tired shoulders. In this manner we laboriously made our way down the centre of the river, stumbling over obstructions, and hauling slabs of stone out of the way in order that the canoes might pass. As might be expected, the river took its toll of our food supply. Canoes were upset and cargoes precipitated into the rushing waters never to be recovered. In order to make up for their losses we had to turn our hand to fishing, and I must say that results were entirely satisfactory. Many were the banquets we enjoyed in consequence. On account of high temperature we were obliged to eat our fish within a few hours, otherwise it would go bad. Even with the rice and beans we had to be careful. If they got damp they fermented and became useless.

There was one aspect of the river which we found particularly tantalizing. In several places it ran in tranquil reaches, suggesting that all our troubles had come to an end, but we soon learned to dread these quiet stretches. It was a case of the calm before the storm. Sooner or later a fringe of ugly rocks would loom ahead, thrust skyward like a row of black teeth. Into the very jaws of these we would navigate, picking our course with the greatest care. Then at a critical moment we would plunge again into the foaming mass. We would slip on the polished boulders, be thrown painfully against sharp corners by the force of the current, and be generally banged about until our whole bodies were bruised and cut unmercifully. Between four and five o'clock in the afternoon we would crawl out on the bank like a family of drowned rats, and make camp for the night. From information given us by our Bakari Indians we expected to reach the zone inhabited by the Anauquás in about six days of easy river travel. It actually took us twenty-seven of the most persistent toil that we experienced on the entire journey. The distance was relatively short, barely 60 miles in a straight line, yet the innumerable loops and turns which the river described almost trebled that distance.

During the twenty-seven days which we took to reach this zone occupied by the Anauquás we spent four in camp and twenty-three on the move. We passed the mouths of two rivers almost as large as the Kuluseu. On the ninth day, half an hour before coming across a big drop in the river, we encountered a stream on our right; on the twenty-sixth day another large river came in on the east bank, called Pacuina by the Indians. A small stream on the seventh day on the west, and on the ninth on the east; on the thirteenth one on the west. Of little creeks we found many on the ninth, tenth and twelfth days on each bank. On the fifteenth and twenty-fourth days we encountered rapids of considerable drop. Of the twenty-three days we were on the move only one day was free of rapids. We found mosquitos first on the twenty-fifth day, and on the seventeenth day at the head of rapids we found a camping-ground with a Y cut on a tree, which was one of Fawcett's camping-places, so Bernadino said.

When we reached the country of the Anauquás my companions expected to find a group of Indian huts lining the bank, and were surprised when Bernadino indicated a spot to land identical in every respect with miles of scenery

upon which we had been gazing since the day we embarked up-river. Not a single hut, not even a clearing, was there to suggest inhabitants. We beached the canoes on a thin strip of sand and climbed the steep bank, where we found João Climaco already established in the forest. He had arrived the day before us and had everything in readiness for our occupation. A number of Indians, he told us, had already visited the place, and to these he had given presents. They had spread the news abroad, and in consequence others had collected and slung their hammocks amongst the trees close at hand, where they were making themselves comfortably at home in expectation.

These were the first real Indians that we encountered, and as such aroused considerable interest. The Bakaris who had come with us from the Government outpost were quite civilized in comparison. They spoke Portuguese, wore clothing, and thoroughly understood the white man's peculiarities. On the other hand, these new denizens of the forest were as primitive as Adam and Eve. They were completely naked; the men cut their hair short like a mop, whereas the women allowed it to grow long. The men were full of laughter and apparently quite at ease. Each carried a bow 5 or 6 feet long and an assortment of arrows. The women wore few articles of adornment. Most of them carried babies, and were decidedly shy at first, but as time went on they became more aggressive and inquisitive than the men. They presented a curious spectacle in the forest, their brown skins harmonizing with the various shades of the jungle. Having absolutely nothing to do, they hung about watching every move we made, like so many hawks. If a box was opened they clustered round to see what mysterious objects were hidden in it. A constant guard had to be kept on the baggage and a barricade made around the cook's quarters. There was no such thing as privacy. A shirt could not be changed or a pair of trousers taken off without a number of Indians crowding about to remark on the operation, finger the material, and ask by unmistakable gestures to be presented with the garments.

Our camp established and the baggage piled where it was under our immediate observation, we started inquiries about Colonel Fawcett. It seemed that he had spent three nights at this spot, and then travelled east on foot to the malocas of these very Indians, the Anauquás. Bernadino showed us the exact site of his camp. It was a small clearing not far off, with one of the Y-shaped stakes used for supporting the cooking-pots over the fire still in place. Bernadino had not gone farther than this place, but had returned up-river with the two canoes which Fawcett had borrowed. There was evidently information of value to be had from these Indians, which only a visit to their malocas would disclose. Hence my first consideration was to go there.

According to custom the Anauquá village was not near the river. Indians have a natural aversion to settling on highways, where enemies can find them. The suitability of the ground for growing mandioca determines the locality of their inland villages, and the proximity of such forest products as *piqui*, which the Indians consume in large quantities during the season that the fruit matures. It was a two-and-a-half hours' walk through the jungle before we reached the Anauquá village. The trail was good; we traversed open country, skirted marshes, and ended in an open spot on the farther side of a wide belt of timber.

De Mello and Gerrard Martin remained to guard the camp while Whitehead and Sam Martin went with me. About twenty Indians accompanied us, and as we approached their village several of them ran ahead to announce our arrival. When least expecting it we came upon a group of seven huts built around an open space clear of vegetation. The roofs of the dwellings were heavily thatched with palm leaves and extended clear down to the ground with little or no walls. Each had two doors, one opening on to the clearing, the other to the jungle behind. Shouts were heard as we drew near and swarms of brown figures came crowding out of the huts, evidently very excited at the advent of strangers. We were taken to the house of the chief, who lived on the far side of the village. His name was Aloique, a short, stocky fellow of muscular build with small eyes that had an unpleasant shifty expression. His coarse black hair was cut after the manner of the other men, with the usual circular patch on the top of the head. There was nothing about his appearance to indicate that he differed in any respect from other members of the tribe.

Aloique invited us all to be seated, not in the cool shade of his house, but on a log in the middle of the square around which the houses were arranged. A large palm-leaf mat was unrolled on the ground, and upon this many of the Indians squatted. Others swarmed about us, standing or crouching on the dry sandy soil, while a brilliant sun blazed down upon us. Conversation through a Bakari Indian who knew something of the Anauquá language was rather limited and we found it possible to do almost as well by means of signs. One topic of common interest which our friends seemed anxious to discuss was that of their family relations. Every man wanted to acquaint us with his children, and the women were equally anxious to claim their own. Thus we were soon acquainted with the various families. While I sat conversing in a limited sense, but making up for the deficiency by handing out a few trinkets, Whitehead and Sam Martin tried to get photographs of the extraordinary scene. It was not easy, because inquisitive bystanders clustered about the instrument and hindered the work.

Physically, these Indians were a fine-looking lot. They were dark brown in colour, although several were a very pale shade of brown, suggesting a strain of white blood. Their features were pleasant, and, apart from curious patterns painted on their lithe bodies, they were not grotesquely ornamented. There was not a single fat person amongst them, and I saw only two old women. I do not suppose there is much inducement to live to a good old age in these parts. The children were alert, quite ready to play, and as full of jokes as their parents. Had it not been for the insistent demands made on us for knives and clothing, and the necessity for refusing to part with our possessions, we should have found our visit most enjoyable. They seemed to think that no man should require more than one garment. If you wore a coat, then there was no need to wear a shirt beneath it, and it was your duty to give one of the two away.

During the height of the conversation Aloique's wife squirmed her way into the group, carrying her youngest son, an infant about two years old, in her arms. I had been distributing some souvenirs in the shape of triangular brass tags bearing the letters G. M. D. She wanted one for her son. The child had several ornaments hanging about its neck, and at the end of one string dangled a small oval brass plate, bearing the words: "W. S. Silver and Company, King

William House, Eastcheap, London." This was a name-plate which must have been removed from some of Fawcett's luggage.* How had the child got it? That gave me something to think about; but I was to get a greater surprise a few moments later, when I stumbled up against something hard inside Aloique's maloca. On closer inspection it turned out to be a small metal trunk, similar to those used by British Army officers in the East. There could be no mistaking it. I have seen too many of them in my life to have any doubts. The box could have belonged to no one but an Englishman; and who but Colonel Fawcett?†

I wanted to make immediate inquiries as to how Aloique came to have it in his possession. It was not possible to approach the subject without raising suspicions, so I awaited a more favourable opportunity.

I got talking with a man called Cabuzala. Every one knew about the three tall *caraibas* who had passed through their village, so I asked him about Colonel Fawcett. He told me a considerable story, most of it quite unintelligible, but it was obviously of interest, and with patience I arrived at the important fact that he, Cabuzala, with Aloique, two women and two young men (the last being doubtful) had accompanied Fawcett a day's march to the east of the Kuluene river, carrying farinha and other stores. Without losing time I suggested that the same men should accompany me to the Kuluene and beyond, but there was much shaking of heads on all sides. The only response to my appeal for volunteers was the one word *Suyá*, at which each man would hit the back of his head with the edge of his flattened hand, at the same time making a hideous grimace. We knew enough of the Suyá Indians and their ways to interpret the meaning of these gestures. The Suyás were a warlike tribe, who under guise of friendliness approach a stranger and at the first opportunity hit him over the back of the head. I was not surprised to run up against such opposition, as it is always difficult to find Indians willing to travel into hostile territory.

Before we left I brought Aloique and Cabuzala together and explained that I required some four or five men to accompany me to the Kuluene, and that presents would be forthcoming for those who went. In dealing with these Indians you always work through the chief of a household. You state your wishes and offer knives, etc., as presents. Then the chief either comes himself or sends some young men of his family, who in turn must receive further gifts when their work is completed. There is no guarantee even after you have made the first distribution of presents that the men appointed will come. At the last moment they may fail you. Other men have then to be procured and more presents handed out. Altogether it is a most unsatisfactory way of doing

*Messrs. Silver & Edgington, Ltd., inform us that in November 1924 they supplied to Colonel Fawcett ten air-tight cases, each of which had a metal plate soldered to it similar to that described.—Ed. *G.J.*

†It has been remarked that Colonel Fawcett was travelling very light, and that he was not likely to have with him a comparatively heavy metal travelling trunk, while sending back his instruments. Or if it had been his, it might have belonged to the 1920 outfit. On this Mr. Dyott points out that it is wrong to imagine the Fawcett party marching with only what they could carry in packs. They had baggage animals to the Kuluseu, and descended that river in canoes to the Anauquá territory. Hence the box might have been carried in 1925.—Ed. *G.J.*

Overlooking the headwaters of the Kuluseu

Crossing the Batovi near Dead Horse Camp

One of the small bark canoes

business, but there is no alternative to fall back upon. Considerable skill is required to bring about deals of this kind. On this occasion we distributed a few small presents to the chiefs of the two households from whom we expected to get men. This was to induce a more friendly atmosphere, and was followed by a request that the chiefs should come to our encampment to discuss the matter.

The afternoon was now well advanced and it was time to be going. All our gear had been collected ready to start back, and we were about to leave when an Indian hurried up to us carrying in his outstretched hands a large gourd full of farinha. Tact compelled us to accept the gift, though it was offered with a motive. He was followed by a second and a third, and so on, until men, women and children alike were bringing us handfuls of it. A sack was produced, and within ten minutes we found ourselves with over seventy-five pounds of it. At the best of times we had little use for this gritty substance, but our real concern was that each donor expected a knife or an axe in return for the small quantity he had given us. In other words, that sack of farinha would cost us at least four dozen valuable knives. We persuaded an Indian to carry the sack back to camp and made a start for home before any more presents could be forced upon us. To our consternation the entire village followed at our heels with the obvious intention of spending the night out, for each had his hammock rolled up and slung over his shoulder. My heart sank at the thought. There was to be no peace for us, that was evident, and how was I to dispatch all of our cargo down the Kuluseu when surrounded by so many inquisitive eyes?

I had planned to send the major portion of my expedition down the Kuluseu to where it joined the Kuluene. Here they would camp and wait for me, while I did a little scouting across country with the Anauquás. My intention was to gain the banks of the Kuluene and descend it in some Indian canoe, join up with my party, and then make further plans. Our cargoes had suffered much on our way down the Kuluseu. After so many immersions in the rapids the contents of the boxes were damp and needed complete overhauling, drying, and sorting. With such a crowd of Indians hanging about us it would be impossible to open a single box.

So we returned to the Kuluseu, hurriedly crossed in the one and only canoe available, and before sending it back had cleared camp against invasion. One or two cases had to be opened hastily and such articles extracted as we intended giving Aloique and Cabuzala for their services, together with several dozen knives for those who had presented us with farinha. From the moment our unwelcome guests made the crossing we had not a moment's peace. Nor was there the least chance of rearranging our cargoes. Our only hope of safety was to push off down-river at daybreak. Even this was not as easy as it seemed. If I was to make an overland trek I must sort over my personal belongings most carefully without any one looking on. The impossibility became more apparent as the number of our brown visitors increased. Each member of my party was completely surrounded by Indians anxious to examine his possessions. All we could do was to sit on our camp cots and keep everything discreetly out of sight. In vain we tried to look pleasant and be friendly, but each moment became more difficult. We had given out presents to those who had

One of the small bark canoes

given us farinha, hoping they would go home. But they refused to move, presumably thinking that if they waited long enough further offerings might be forthcoming.

If the caraiba would only go to sleep, it would be so easy to take something of value unobserved. I shall never forget that night as I lay full length grasping a rifle, a revolver, two machetes, fourteen knives, and an assortment of hardware in my arms, pretending to be comfortably asleep. I was desperately tired, yet dared not sleep even for a moment. Several times I was conscious of stealthy fingers trying to find an opening into my sleeping-bag. But at 1.30 a.m. all further attempts were abandoned, and the Indians took to their hammocks. At 2.30 I got up and quietly set about the work of packing. By the time daylight began to filter through the branches overhead I had unpacked all my personal effects and sorted and rearranged them ready for my start overland.

While some of us remained on guard the camaradas carried the baggage down the steep bank and loaded up the canoes which were in readiness below. At nine all was stored on board and our fleet shoved off from shore. I stood on the eastern bank and watched them go. João Climaco was beside me. He had decided at the last moment to come along, and we took a young Bakari Indian to help us. The understanding arrived at with Aloique and Cabuzala was that we should proceed without delay to the Kuluene. We certainly made a splendid start. The Indians were going home to their malocas, and we made good time in consequence. Within two and a half hours we were seated inside the cool and spacious house of Cabuzala ready to continue. Although João Climaco and myself were ready, it was not so with our Indian friends. We endeavoured to hasten matters by giving the presents promised, such as axes, knives, and ornaments. But still there was much hesitating and talking on their part. We eventually got to the bottom of the trouble. There was to be some special ceremonial dancing that evening at which every one wanted to be present. There was no counter attraction we could offer that would in any way compete, so we resigned ourselves to the inevitable. I was not altogether sorry about the delay, as another day with the Indians would prove intensely interesting, but my companion was annoyed that we could not advance immediately. For one thing, our only food consisted of a small sack of dry farinha mixed with some still drier meat, and the prospect of living on this for a day longer than was necessary was not pleasant.

My thoughts kept on turning to that metal trunk I had seen in Aloique's house. This seemed the very opportunity to find out its history, so I sauntered over and made myself at home with the family. I noticed that alongside the box were a couple of very large baskets containing farinha. I commented upon their size, and then, appearing to notice the tin box for the first time, I pointed to it and indicated how nice it was. I asked Aloique where he got it, and was told after a little hesitation that one of the tall caraibas had given it to him for carrying it to the Kuluene River full of farinha. His manner warned me not to accept this story at its face value. Conversation once launched on the subject of Fawcett, I would not drop it. I tried in all manner of ways to find out what Aloique knew of the three Englishmen, but it was a difficult subject to tackle in the sign language. No other method was possible because my knowledge of

their words was confined to a handful of nouns I had picked up casually since my arrival. After considerable effort I gathered that Aloique and Cabuzala had accompanied Fawcett for one day east of the Kuluene River, and that from there on the explorers had advanced by themselves. I also learned that one of the three found it difficult to walk. The place where Aloique left Fawcett was one of the dismal areas covered with piqui trees. For six months, during the dry season, no rain falls, and everything gets as dry as toast. The fruit of the piqui is eaten in large quantities by the Indians. They make special excursions to the place where it is found. Aloique informed me that as far as the piqui grove the trail was very clear and distinct, but beyond it branched into many tracks which eventually lost themselves in the jungle. He concluded by indicating that Fawcett and his companions had died of thirst. There was very little doubt that I interpreted Aloique's signs correctly, but, like other of his stories, I began to have suspicions as to its exact truth. It seemed probable that he knew more than he admitted.

Later on in the day I suggested that instead of descending the Kuluene River we should all cross to the opposite bank and follow Fawcett's trail into the jungle to see where he went. Aloique scowled at the idea, and his small eyes shot evil glances as he said, "Suyás, Suyás, bad people, no good," at which Cabuzala nodded his head in assent, and proceeded to give us a graphic demonstration of how the Suyás would treat us if we crossed their path. It appeared that if we encountered them they would either hit us over the head or else come up from behind when we were seated and break our backs across their knees. The Suyás are a repulsive tribe to meet. There is no mistaking them, because they insert large circular blocks of wood in the lower lip and pierce the lobe of the ear with sticks. Instead of cutting their hair in a neat bob after the manner of the Anaquás they let it grow long and shaggy.

An interesting diversion interrupted further conversation. Rapatzi, one of Aloique's unmarried sons, with one of Cabuzala's boys, appeared in the doorway with a pair of large wooden horns used in ceremonial dances. Upon these they made the most extraordinary noise, waving the instruments up and down while they blew, stamping their feet in perfect unison. They were dressed up in fantastic feather ornaments. Suddenly they made a dash outside the house, closely followed by a girl holding Rapatzi's shoulder with her left hand. Off they went across the open space and disappeared into the house opposite. The music, which was suggestive of the droning of bagpipes, continued, and in a few minutes out they came again, passing into another house until each had been visited in turn by the three.

In the evening a more elaborate affair was staged inside the houses. The dancers visited each house in succession, sometimes making two or three visits. The long horns were used again, and while the men formed into two lines lengthwise to the house, the women were drawn up in two rows at right angles to the men. The latter held their hands outstretched and stamped their feet; the women rested one arm on the shoulder of their adjacent companion and swung one foot back and forth in time to the music.

When all the dancing was over, the two doors of the house in which I was sleeping were closed for the night and every one retired to their hammocks. There were some eighty people in Cabuzala's establishment, all related. Each

family group kept by itself, their hammocks slung together, and two or three people sometimes in one. Each group had a fire to itself, which was kept burning all through the night. Sometimes there would be two or three. It is very cold as soon as the sun goes down, and a single blanket was hardly sufficient to keep me warm, so I was not surprised to see the naked Indians getting up continually to warm their shivering bones by the fire.

At four o'clock I awoke cold and stiff on the hard floor of the maloca. No one stirred. The festivities of the night before had proved too much, and I was fearful that our plans might miscarry. We had given away our presents, and only a few remained for an emergency. There was a chance that no one would go with us, and we should be marooned in this place unable to join up with the rest of the party. With feelings of relief we heard of other Indians desiring to go with us. Three men from the Kalapalo tribe were visiting Cabuzala for a few days and had decided that this was a good time to go home. Our route apparently coincided with theirs, and it was an easy way for them to earn a good knife by accompanying us that far.

At 7 o'clock we started, accompanied by Aloique, Rapatzi, and three Kalapalo Indians. Each of us carried considerable loads, the Indians shouldering less than we did. For two hours we traversed a muddy stretch of country. Bog land extended to the right and left. Apparently the trail was leading us into the heart of a tremendous swamp. It ended abruptly on a solitary patch of dry ground with water on all sides except the one we had come by. To our surprise we found sixty or seventy Indians, men and women, sitting on the ground. Several very rickety canoes were produced, into which we clambered, and paddled off through narrow channels of deep water. Twenty minutes later we were once more on terra firma, striking across open grassy country that bo ⁻ed the swamp, and here we encountered a solitary Anaquá Indian. Aloique at once roped him in to help us and gave him his load to shoulder. I was surprised to note how reluctant the men were to carry anything. It is a woman's task, and the men make a terrible fuss over the smallest bundle. They won't sling it on their backs, as the women do, but prefer to rest it uncomfortably on the shoulder and steady it with one hand, this being a more manly method. Aloique was a heavy-set fellow and should have been capable of carrying a house. Yet his grunts and groans under a thirty-pound parcel were childlike. The new Indian, Matuala by name, took Aloique's load cheerfully and handed his bow and arrows to Aloique to carry. The result was an appreciable increase in speed.

We tramped on a couple of hours farther, and once more halted on the edge of a swamp. Two canoes were again conjured up from the tall grass, and we paddled off down a labyrinth of narrow canals. It was the most charming spot I had seen for a long time. Palms waved their delicate fronds overhead. Birds and butterflies were numerous, while the combination of light and shadow on all sides was entrancing. It would be easy to get lost in such a place. Yet our canoes moved along without the slightest hesitation on the part of their pilots. Suddenly we glided out of a particularly narrow channel, into the glaring light of the noon-day sun, and found ourselves on a lake whose farther shore was barely visible to our dazzled eyes. For one and a half hours in our tiny bark canoes we skirted the fringe of this lake, feeling extra-

ordinarily insignificant. Our exit was just as sudden as our entry. We turned sharply in under some trees where we could barely pass, and for a short time wriggled through a belt of dense forest, emerging on a large swampy plain covered with Buriti palms. Here watercourses ran in all directions, reflecting the most glorious shades of green. So clear were their emerald depths that we could see the bottom in every detail 30 to 40 feet beneath us. It was only after we had been afloat for three hours that we beached our canoes on solid ground and prepared to continue on foot. But a good camping-place, plenty of firewood, and fat fish to roast were like sheet anchors; the Indians would go no farther. Next day, at noon, we should reach the Kalapalo malocas. There was no need to hurry.

Barely 200 yards away was an open space with the charred remains of several houses rising out of the jungle. In these malocas Fawcett, they said, spent a night. They had been abandoned a few months prior to our arrival, and, as is the Indian custom, had been burned when the occupants changed their place of residence. I found one of Fawcett's powder flasks on the ground, or rather, Aloique called my attention to it. He also informed me that Fawcett had not travelled the way we had, by canoe, but had taken a roundabout course by land. The women who were carrying his cargoes, however, made the trip by water.

Our third day's march brought us to the malocas of the Kalapalo Indians, and was a severe trial of endurance. After breaking camp we tramped for several hours through a dry forest without seeing a drop of water. After five hours we arrived at a small brook, where another of Fawcett's camps was located. We did not stop, but proceeded on through the brittle wilderness, dead leaves crackling under our feet, and trees that looked dead and withered clutching with their claw-like branches at the sky. When I noted the extraordinary dryness of the forest, and realized how short some of Fawcett's marches had been, it seemed that Aloique's statement about his dying of thirst was not only possible but quite probable.

We arrived in the village of the Kalapalos at 3 p.m., tired after our exertions. Four chiefs received us, seats were provided, and there in the blazing sun we received the best our hosts had to offer. Vile drinks, dirty farinha cakes, and rancid piqui were placed before us. It went against the grain to accept these things. Not only were they useless to us as food, but each present meant something in return, and our small packs contained a very limited supply of such things.

We found the Kalapalos identical in every respect with the Anauquás, except that they had words in their vocabulary peculiar to themselves. In spite of such differences they seemed to understand each other perfectly. Their houses were built in a similar fashion, although this village was double the size of the one we had just left. It contained about fourteen houses, and each establishment accommodated eighty to two hundred people. The Kalapalos impressed me as being more friendly than the Anauquás; but for some reason Aloique did not feel at ease. On arrival he gave a long oration, pitched in a high voice, and addressed his remarks to the wind, for he never looked any one in the eye. He seemed greatly relieved when he had made it, for he then retired into the background, apparently not wishing to appear in the limelight any further. His companions, Rapatzi and Matuala, behaved very

differently. They went visiting from house to house and enjoyed themselves immensely.

There was not much chance of my going far afield, as João Climaco and I were directed to a maloca shortly after our arrival and never moved from it until we set out on our journey next day. The house was new, not quite completed; even the doors had not been cut out, and we were forced to crawl in under the eaves on our hands and knees. With difficulty we got our baggage safely inside, piled it up against a wall, and then sat down in front of it. The attention which we received at the hands of the entire tribe was embarrassing. The women would roll up my sleeves and examine my arms with exclamations of surprise to see for themselves that white skin extended beyond the hands and arm. Three older women brought their grown-up daughters and plainly enough offered them in marriage. One was particularly persistent. This was quite a new experience for me. Evidently the women in these tribes hold a position entirely different from that in most others in the Amazon country, where men have most of the say.

One of the leading Kalapalos informed us that no one cared to travel with us to the Kuluene, although he himself was willing to let us have his canoes if we could come to a bargain. Our position with these Indians was as if we had been abandoned in some foreign country without money to pay our passage home. We had practically no presents left to give away, having disposed of our supply before leaving the malocas of the Anauquás. We tried vainly to establish credit by explaining that we had a good bank account at our own camp where the Kuluene and the Kuluseu joined. We had already distributed a few small knives and fishhooks to the head men of the village, but these did not represent sufficient advance payment to cover the risk involved. I then remembered some cheap jewellery my wife had bought for this purpose before leaving New York. Nothing could have proved more acceptable. Earrings and pins were quickly grabbed by the men, who promised without further argument to join us on the morrow. In trying to explain to them the reason for our not having a larger store of presents we went through a pantomime of carrying heavy loads, and how sore and tired we felt from packing even the few things we had with us. This was interpreted by the Indians to mean that we were tired and wanted to rest for a few days. The moment we understood that, we had to correct the wrong impression, which was not easy. The Indians have no universal sign language, like the North American redskins, and it requires a nimble wit to piece together into an intelligible whole fragmentary ideas which are suggested by movements of the hands and head.

During my brief stay with the Kalapalos I noted with special interest some of the ornaments worn by them, of artistic and unusual design, especially stones, curiously shaped. One, a large Maltese cross about 2 inches in diameter, worn by a woman, was well cut out of hard diorite. Some of the men had circular rings of the same stone, or fragments shaped like hammer heads. Another woman had a doll made out of pottery suggestive of Inca art.

Colonel Fawcett, I understood, remained one night with the Kalapalos and continued the next morning to the Kuluene. I asked the chief what he knew about the three tall men, and through the medium of gestures I gathered that they had been killed. He said that the Anauquá Indians were bad people. He

also told me that one of the three had been lame and could not walk very fast. I asked how he knew Fawcett had been killed by Indians. "Kalapalos follow," he said. "One day we see smoke from camp fire. Two day we see smoke from camp fire. Three day we see smoke. Four day we see smoke. Five day no smoke. Caraibas killed by Indian—Anauquá Indians bad people." If the story was true, Fawcett's party had been murdered at their first camp beyond the dry zone where grew the piqui trees of which Aloique had spoken. I learned further that the Kalapalo Indians had followed Fawcett's tracks a month or so later when they had gone to collect the crop. There they had then found some black and yellow feathers dangling from a string tied between two saplings on either side of the trail: a recognized warning not to pass beyond for fear of death.

At the first opportunity I confronted Aloique with the information. "Suyás!" he said. "Suyá Indians killed Fawcett." He then intimated that he also had followed and found the signal, which he claimed Fawcett had made. I suggested that it was the Suyás who had put up the warning, but Aloique shook his head and as usual had a glib explanation to offer. "Caraiba put up signal. String not used by Indians. String belong to caraibas, and caraiba shoot bird with gun. Sign put up by caraibas to show the road they had taken." The story was now getting involved, and Aloique had contradicted himself several times. There was no doubt that I had interpreted his story correctly on each occasion it was told. The signs had to be repeated dozens of times and passed back and forth between each of us before I felt justified in assuming the meaning I have attached to them.

At eleven the following morning we were on our way to the Kuluene. There was the usual bickering, discussion, and hesitation before starting, but the earrings and jewellery had done the trick. It looked as if the rest of our journey would be carried through without a hitch. For three hours we trudged along a path that eventually brought us to the margin of a wide expanse of water, and I noticed several Y-shaped cuts on a tree-trunk, a symbol that I had seen in many places along the route we had followed as Fawcett's.* On arriving at the water's edge we supposed it to be the bank of the Kuluene, but it was only one of many lakes which adjoin the river. Twenty minutes later we arrived at the Kuluene, a fairly wide smooth-running stream, on the other side of which large sand-bars were exposed. We pitched our camp on a high bank amongst some trees, and while my companion kept guard I went off to investigate the lie of the land. While I was standing in one of the canoes belonging to the Kalapalos with Rapatzi and Aloique, the latter motioned to the opposite bank. "Would I like to see where the caraibas went?" Naturally I was ready for anything, and nodded assent. On the farther side of the river we struck out across some open sandy ground, in the centre of which was a tree. Around the base of this tree the remnants of an Indian house still remained. The tree had been hacked about considerably with knives, but on one side a succession of Y cuts was visible. I

*Mr. Dyott has explained in conversation that these Y-shaped marks were cut in groups so that they made a pattern of several rather elongated hexagons, like a small piece of wire netting. He associates these marks with the places where he believed Colonel Fawcett camped, and is inclined to attribute them to one of his party.—ED. *G.J.*

pointed to the house and, looking at Aloique, said, "Caraiba?" At the same time I laid my head on my hands and snored. In other words, "Had Fawcett slept here?" Aloique nodded, and holding up the first finger of one hand held the tip of it with his left. Fawcett had stopped one night in this place, which at that time had been occupied by Indians.

We came to a long neck of water reaching inland from the river. Here amongst some dense bushes were concealed two canoes which we were to use on our journey down-river. Satisfied that they were all in order, we proceeded to climb a very high bank, threaded our way through an old Indian plantation, and crossed more open country on the farther side of which was dense forest. The faint pathway which we were following disappeared in its sombre shade. We stopped, and Aloique broke the silence.

He pointed due east and said, "Caraiba. Puc, puc, puc," at the same time waving his hands back and forth to imitate a man walking. "Um!" he exclaimed in a long-drawn-out breath, paused, and looked about as if to get his bearings. "Iti!" And his arm moved slowly over his head east to west. He placed his head on his hands and snored. Then one brown finger was held up. "Um" again, and "Iti," as his muscular arm went sweeping around, and once more his head was inclined on his hands. "Um," and the performance was repeated a third time. Five times in succession he went through this pantomime until five fingers were held up to view. There was another ominous pause. Indians never seem to hurry their conversation. Aloique looked about him as if his animal brain was thinking how to express itself more forcibly. His eyes began to turn significantly from side to side as if suspicious of the Suyás. Then suddenly he shouted, "Suyás, Suyás!" in quick succession. His arms were thrust out and pulled back to his chest many times, indicating the unexpected arrival from all directions of this warlike tribe. "Caraiba." He relaxed and put his hands on my shoulder, saying "Asu," and went through the motions of a man telling me to be seated. Then both hands were extended in my direction as if offering food. "Kine—Kine," he said, and I found myself seated on the trunk of a fallen tree, with Aloique, all smiles, squatting down on his haunches in front of me. It was all done very deliberately, as he bade me accept the imaginary food contained in his cup-shaped hands. Meanwhile his companion Rapatzi edged around, and I had trouble keeping both of them in sight. For a moment Aloique stood up. He took a stick lying on the ground, and creeping round behind me hid it in the sandy soil at my back. During this manœuvre he held his hand to his mouth to indicate silence. Returning one more he appeared to offer me food, and while soft words of persuasion fell from his lips he leapt up in the air like a madman. The finale was reached, and in a most dramatic manner imaginable he yelled: "Suyás, bung-bung-bung!" at the same time hitting himself three violent blows on the back of the neck with his flattened hand. "Caraiba," he exclaimed, and collapsed in a senseless heap on the ground as if he himself had been killed. During the latter part of the performance Rapatzi joined in. He slipped in behind me and grabbing the club out of the sand went through the motions of hitting some one over the head.

So this was Aloique's story of Colonel Fawcett. He had travelled five days beyond this point, heading due east. The Suyás had waylaid him, and

Tree-trunks astride the banks of the Kuluseu

The only falls on the Kuluseu

Anauquá family outside a maloca

approaching under the guise of friendship had killed the entire party. Somehow or other I did not believe the story entirely. By the camp fire that evening João Climaco and I tried to get further particulars, but the only information we got was that the Anauquás were good Indians and did not kill people. My own interpretation was that Aloique had not only done the killing but had intentionally made the sign of the feathers so that his companions would not follow, and consequently he would not be called upon to divide the spoil with the rest of the tribe. I suggested that we should defer our departure a day or two and follow Fawcett's tracks; but Aloique excused himself on the ground that he did not know the trail. Cabuzala and two women, he said, were the only people Fawcett took with him, and they only went for one day, while he, Aloique, had not been farther than the banks of the Kuluene. This was another contradiction.

The next morning we left in three canoes, all leaking badly, particularly the one I travelled in. All day as I sat in that shallow saucer half full of water my thoughts turned to Fawcett and the tragic fate that had overtaken his splendid effort. His trail led east, yet here was I turning northward, abandoning the final issue of my expedition. Plan after plan revolved in my mind, but there seemed little I could do. It was absurd even to think of going off by myself if no Indians would join me. My companions were down-river; but even if I brought the entire party upstream I should be no better off. After deliberation I decided to join my party as agreed. Once they were settled in a pleasant spot where they could wait a month or more with the least possible risk, I could return upstream and by some means or other persuade Indians to make that remaining five days' march eastward. When all was said and done there was only one Indian who could take me to the fatal spot, and he was Aloique.

The next problem was how to get Aloique to join me, and how to explain to him that I wanted to see evidence of the murder that had been committed. Another point to consider was the matter of food. My party had lost a good deal in the rapids, and therefore I could not absent myself very long without endangering the lives of my men. The rate at which our store of presents was dwindling was a further question to consider. I might not have enough to go round, especially if on descending the Xingu we ran into other tribes as avaricious as the Anauquás.

Barely an hour after starting the Indians suggested that we should spend a little time fishing. We had been joined by another canoe filled with Kalapalos, and the occupants of all four boats were hungry. The Indians obtained their fish by bow and arrow. They did not use hooks, although we gave them plenty and instructed them in the art of using them. Between us we managed to procure all we could eat, and were never short, though Indian appetite is never satisfied. He kills everything in sight no matter how much he already has.

Next morning, as I sat by the camp fire enjoying a baked piranha for breakfast, I tried to figure out some way of approaching Aloique. To convey to him the thought that I wanted to see what remained of the tragedy in the jungle was no easy task, and I racked my brain to think of signs by which to interpret my ideas. Beside the fire was a pile of fishbones picked clean, and as I gazed at them in a semi-conscious way, Aloique came up and sat down on the opposite side of the comfortable blaze. I looked at him in surprise. He was

wearing a pair of khaki trousers that were distinctly of English cut. I had a sample of the material from which Fawcett's clothing was made, and although in texture it seemed to agree, it struck me as being considerably lighter than the specimens which I carried in my baggage. As my eyes turned on that pile of bones, an idea suddenly came to me. "What do you call those?" I asked Aloique, pointing to the remains of the fish beside the fire. "Itzurapa," he replied. Then said I by means of signs, "If you show me the bones of the caraiba, where they lie in the jungle, I will give you my rifle and a shirt." He did not jump at my offer, but quietly nodded his head in assent. In going over with him the number of days necessary to make the journey I suggested that we should take at least five, but he corrected me and said it would only take us four. That was quite satisfactory to me, and in order to check him still further I drew in the sand rough diagrams of how we should go. He seemed to be precise as to the locality and had apparently visited the spot recently, although formerly he had denied crossing the Kuluene. Of his own accord he volunteered the information that only large bones remained, indicating the skull, pelvis, and certain bones of the leg. All smaller fragments apparently had disappeared. I was thoroughly satisfied with our conversation, and feeling confident that Aloique fully understood me and I him, I let the matter drop.

It was to be an eventful day for us. As we were paddling round a bend four small canoes darted across our path and made fast on a sandbar. "Wicuru," whispered Matuala, and with that our four canoes hurriedly drew in alongside each other. We drifted slowly downstream towards the new arrivals. A meeting was inevitable and obviously not to the liking of either the Anauquás or Kalapalos, for all remained silent and looked very glum. On drawing near the sandbar one of the Wicuru canoes pointed its bow out into the stream to intercept us. I shouted to the strangers to relieve the tension, and it had its effect. The Wicurus started to chatter like a cageful of monkeys. At the time I had not the least idea what it was all about. But later, when they said how news of our arrival in the district had been sent by the Mantizula Indians, we knew they had come to receive presents such as they supposed we had given their friends. Vainly we tried to get Aloique to help us out. It was so easy for him to explain that we had no presents, that we had come overland, and our shoulders were not broad enough to carry many axes or knives. He had heard all this before, when we conversed for the first time with the Kalapalos, yet he did not utter a word. He sat like an embarrassed child hanging his head and refusing to speak.

João Climaco had some odds and ends in his pocket, and calling to the chief we gave him a few trifles, explaining our predicament as far as we were able. For a time, at any rate, the situation was relieved: but it proved only a temporary measure, because we heard that many of the Wicuru tribe had walked to the bank of the Kuluene river and had been waiting three days for us to pass. The conference wound up with promises, and we continued on our way. The Wicurus maintained a respectable distance until late in the afternoon, when they drew up closer. The reason was soon apparent. The river in front of us narrowed where a neck of land stuck out into the stream, reducing the navigable channel to 30 or 40 yards. The point was almost bare of trees, but it rose sharply for 25 feet or more, and was covered

with naked Indians. Apparently the entire Wicuru tribe had migrated across country to intercept us and had taken up this strategic position where they could hold us up at the arrow's point. To have passed through Wicuru territory with Indians of another tribe without stopping for a pow-wow would not have been diplomatic. We pulled up our canoes on the beach with some trepidation, and if the Anauquás had been silent before, I have no words to express their dumbness on this occasion. João Climaco was beside himself with anxiety. "We have nothing," he exclaimed despairingly, as soon as our fragile canoes scraped the sand. "We have come overland carrying packs. We could not bring you presents. Let the chiefs come with us in their canoes and we will give them presents on the morrow." We knew very well that the five canoes of the Wicurus could not carry more than fifteen men, and it would be possible for us to deal with that number. But to find gifts that would satisfy several hundred was impossible. By water the Wicurus could not all follow us because they had few canoes. By land they would be prevented by the waterways that intervened. We should be safe from invasion if we could only get away.

The Wicurus were exceptionally clean-looking, healthy people, and pleasant to look on. A large number had very light skins. Beneath ligatures which they wore on arms and legs the skin was almost white. They were certainly the nearest approach to white Indians that I have ever seen, and sufficiently light to give rise to some of the extraordinary stories Fawcett related about white Indians in these parts. We would not wait for them to think matters over. "Come with us," we said, as we began pushing away from the shore and beckoning them to follow. "Let the chiefs come in their canoes. They will receive knives and axes at our encampment." The gap gradually widened, and before a counter protest could be raised, the swift current had carried us out of range. The Anauquás and Kalapalos needed no urging. We went flying downstream as fast as paddles could drive us, while the swarm of brown human bees buzzed disappointedly on the shore. The Wicurus made full use of such canoes as they had. We camped at seven o'clock, but before darkness settled our numbers were swollen by the arrival of eighteen of their tribesmen, making thirty representatives of three different tribes with us.

After a sleepless night, with thunder and rain, we crept off down the river while it was yet dark, my canoe leaking worse than ever and requiring constant attention. Again I asked Aloique about our projected trip. He seemed quite positive that he could lead me to the spot in four days. I told him that I would take a companion with me, and he informed me that Rapatzi would also go with us, making four in all. Throughout the day the little Wicuru canoes dogged us, keeping at a uniform distance of 500 yards.

When we reached the confluence of the Kuluseu not a sign of our men was to be seen. We were debating what to do when the sound of some one chopping wood echoed through the evening air, and in a side channel was one of our tents pitched in the centre of an extensive sandbar and Whitehead splitting wood for the evening fires.

The main body of the expedition had travelled slowly, having taken five days to reach their objective. A trail of fortune seekers had followed them, and

their numbers were increasing daily. But our camp had been well selected, and its strategic position proved our ultimate salvation.

At this moment João Climaco decided it was necessary for him to return to his family in Cuyabá. His services, with that of two camaradas, had been put at our disposal by the Government for so long as we had need of them. The original idea was to send him back after our investigations had been completed and we had turned our faces northward to Pará. It was evident that the trying situation was getting beyond him and it would be unwise to detain him; but my plans were seriously upset by the news, because I had counted on leaving him at the base camp while I followed Fawcett's trail. If he returned it meant that new canoes would have to be found for us to descend the Xingu. Four canvas boats were not equal to the task, and the bark canoes were too fragile for open river work. With the object of obtaining one more suitable for our purposes he went downstream the following morning, where we were told large canoes could be had from a neighbouring tribe. He expected to return in two days, and then set out for Bakari Post. At 3 p.m. we were surprised to see him once more in his canoe hurrying back up the Kuluene. He went straight to his camp on the opposite bank and sent word over that some Indians were coming up the river in canoes and we should have no difficulty in bartering for one.

We passed an anxious and wearisome day. A further influx of Indians had taken place. Our sandbar swarmed with them and we never had a moment's peace. "Putzinga," meaning gifts, was the word on every one's lips. We were unable to do a stroke of work. Films and photographs had to remain where they were, in wet boxes covered with mildew. It will be remembered that repacking at the Anauquá camp upriver had to be postponed, and although the need for attention was worse than ever, we could do nothing but postpone matters again until a more opportune moment presented itself. My thoughts were pulled in all directions. Photography, wireless, stores, canoe-mending, watching Indians, and, the greatest problem of all, my return to follow Fawcett's trail in two days' time. It seemed as if every obstacle intervened to stop me doing this most important piece of work. The camarada I intended taking, Verissimo by name, openly rebelled against running into such a death-trap. I soothed his fears by saying that I would take another man to keep him company. When I told Aloique of my decision he retaliated with the statement that he also had decided to take another Anauquá Indian, Matuala.

In the late afternoon news reached me via the cook, José, that one of our Indians who understood Anauquá and also spoke some words of Portuguese, had overheard Aloique talking to his companions, the gist of the conversation being that I would not get very far from our first camp; that he, Aloique, would kill me in the way Fawcett had been killed, and would then take everything I possessed. This was startling news, and I had every reason to believe it was true. The two camaradas, Verissimo and Kalin, who were to go with me, were so frightened by it that they implored me not to take them on such a perilous venture. Aloique seemed to be very impatient about getting off, and wanted me not to lose any further time about it. On several occasions during the day he came over to speak to me, but it was not until evening that I told him of my modified plans. We would leave early the next morning, and not

only two of my men, but the entire party would accompany us. He received the news in silence and without comment. I had not the slightest intention of doing this, but I was anxious to see what effect the news would have on him. Besides telling Aloique, I broadcast the news amongst all the Indians present. When darkness fell I was greatly relieved to see those masses of Indians who had swarmed around us during the day fade away to the forest to sleep. We all turned in for the night confident that there would be no trouble. Our one and only tent was within a rope enclosure and the baggage safely stored out of harm's way.

At daybreak I proceeded immediately with my arrangements for going back up the Kuluene with Aloique, but yet another surprise was sprung on me: the Anauquá Indians had vanished; Aloique, Rapatzi, and Matuala had boarded their canoe and decamped during the night. If I was to visit the scene of the Fawcett disaster, I should have to organize my plans afresh and hunt up other Indians to help me. To me it seemed obvious that Aloique, becoming suspicious, feared some plot on his own life, and had decided to slip off before he got caught. It might be argued that he knew nothing of the Fawcett affair, and having made promises which he could not possibly fulfil had fled rather than face an embarrassing issue. My knowledge of Indian psychology makes me think differently. The real motive which swayed Aloique was fear of my having discovered the part he played in the crime, and consequently that I, on my part, was plotting to take his life. Had he not committed the murder it is possible that the reward of a rifle or clothing might have induced him to show us all that remained of that drama in the piqui grove. It might also have caused him to promise more than he could carry out. But it would not have made him turn and run. It must be remembered that all Indians fear vengeance, either from the living or the spirits of the dead. With them reprisals are invariably sought, and if they kill they expect a relative or a fellow-tribesman of the slain to seek their life in return. In this case Aloique might well have thought that something had enabled me to discern the part he had played, and what would be more natural than that I should try to get him to the very spot where his foul deed had been enacted? Superstition would lead him on to think that the spirits of the dead would aid me, and so hopelessly outnumbered, he would not stand a chance of escape.

Although everything seemed to conspire against putting the final touches to our discoveries, I felt in honour bound to leave no stone unturned that would throw light on the untimely end of my fellow-countryman. As the day progressed it became more and more obvious that it would be impossible to do very much more than I had already done. By nightfall things reached such a pitch that the lives of my entire expedition were at stake. It did not require much perception to see that unless we could get clear of these awkward Indians in double quick time, we ourselves would never come out alive.

In the morning the Indians started to become aggressive. They would push their way into our enclosure and openly help themselves to such things as they could lay their hands on. We checked this advance by displaying our rifles and revolvers, which up to now had been kept in the background. On the pretext of cleaning and testing them we advertised the fact that we were able to look after ourselves if need be.

New arrivals, for the most part men armed with bows and arrows, continued to land, their faces aglow with anticipation for the gifts they expected to receive. But as time wore on and no presents were distributed the lines deepened into furrows of growing anger and impatience. At noon a regular fleet of canoes was sighted making their way up the Kuluene. It was from these Indians that João Climaco had tried to get us an extra canoe, and as we witnessed boat after boat discharge its living cargo on the shore we realized with growing concern the seriousness of the situation. The Kamaiula chief, Jacuma, came to greet me with all signs of friendliness, and told me his story. So far as I could piece it together João Climaco had met him the day before and had accepted presents of farinha and other food stuffs for which he, Jacuma, was to receive presents from us on his arrival at our camp. I now began to understand João Climaco's haste and why he had not wanted to tarry any longer with us. He had met these people on his way down-river, accepted their presents without giving anything in return, and left us to settle the bill as best we could, knowing that we were not provided with the means of doing so. Amongst that fleet of Kamaiula cockleshells on our sandbar, not a single one was of any use to us. They were all small and leaky. Furthermore, we found that the bark canoe which João Climaco left behind was not the best one as he informed us, but the worst of the lot, wholly inadequate if we had to fight our way down the Xingu to the Amazon.

At five o'clock I determined on the only course open to us. I called the throng of indignant savages together. "Kamaiula, Caraiba, wow wow wow," said I, pointing to the beach. In other words, "Let the Kamaiula and the white men talk things over." The response was immediate, and they all collected at the water's edge. Slowly and painfully I went through a little act that I had thought out in advance. Over and over again I repeated it, uttering only an occasional word to emphasize my meaning. I pointed wearily to all the Indians grouped round about me and then to the tranquil forest as if to say, "You are all tired, go and sleep." Then I myself lay down on the sand as if exhausted and closed my eyes. For a few seconds I snored. Opening my eyes again I pointed to the east where the sun would rise next day, saying, *Iti*, which means sun. I then got up briskly, opened a lid, and went through the motions of extricating knives and handing them out to the multitude. As a grand finale I got into a canoe and pointed downstream, saying "tuna," which is the Indian word for house; at the same time I again doled out imaginary gifts. All this meant that we were very tired and would first go to sleep. At daybreak, when we felt refreshed, I would open up some boxes and give substantial presents to all, after which I would go down-river to the malocas of the Kamaiulas and give away more presents, returning that same day up the Kuluene. My pantomime was fully understood, so the meeting broke up to the satisfaction of all.

An Indian may go to bed early, but he likes to talk over the events of the day in every detail before going to sleep. This means that by ten or even eleven o'clock he may be still awake. By three in the morning the cold night air has crept into his bones and a few minutes near the warm blaze of a fire is necessary. From midnight on till 2 a.m. is the time that he sleeps heavily. This then was to be our hour of action. At midnight my entire party were up and

doing. Coffee was served, and then in absolute silence the baggage was carried to the river and carefully put on board the canoes. Then the tent was folded up, and by one o'clock all was ready. Nothing was left behind on that sandbar. So long as smooth water lay ahead of us we could run fully loaded without much risk or danger, and I did not want to give the Indians the satisfaction of finding so much as a stick that would suggest a hurried retreat on our part. Stealthily we pushed off from the sandy beach and slid gently into the rapidly moving stream of silver water. I thought the moon would prove our undoing, but the river was too wide and rambling to allow of our being detected. At 30 yards I could barely distinguish the outline of the canoe behind me. At 50 yards only a vague shadow was visible. How little the Indians could see of us from their camps more than 150 yards away can well be imagined. The light was just sufficient for us to steer by and keep in the channel without fear of piling up on some treacherous sand-spit. After covering half a mile or so paddles were produced, but we plied them cautiously. In half an hour we were well out of earshot, and then like galley slaves we dug our blades deep in the water and with long sweeping strokes sent our craft bounding ahead. Bend after bend in the river was left behind. Soon the darkness began to lift; daylight grew, and as the sun climbed we still pushed ahead without pause.

Only after fourteen hours of unremitting toil we sought a camping-place for the night. It had been a hard and exhausting day for all, especially for those of us who were suffering from fever and other complaints. José, the cook, could hardly walk. His legs were swollen to a tremendous size and covered with excruciating sores. João and Verissimo had been down with intermittent fever for over a week, and had little reserve force left to draw upon, but they never shirked their work for a moment. The Martins and Whitehead had all been troubled with spells of sickness, but they also worked like Trojans. De Mello and I were the only entirely healthy dogs of the party.

The sensations we experienced during the next week or so were decidedly odd. We quite expected to be followed, and had therefore always to be on the look-out for trouble. From day to day we never knew what we might not run into in the way of rapids or trouble with other Indian tribes, especially the warlike Suyás who roamed the eastern bank. One morning as we passed the mouth of a small creek coming in on our right we observed an arrow planted in the centre of a miniature sandbank. Amongst Indians this sign is an emphatic warning not to pass beyond if you value your life. Needless to say we were taking no risks, and continued our flight down-river without a pause. Who placed that arrow in such a conspicuous position we knew not, and it gave us an eerie feeling to realize that although we had not seen any one, yet Indian eyes must have been watching us and keeping track of our movements. I have always found that Indians are anxious to avoid contact with strangers, and will employ extraordinary ways of warning the traveller that his presence is distasteful to them. The sign of the feathers hung on a string such as the Kalapalos reported near the scene of the Fawcett tragedy is often adopted. On other occasions a whistling arrow is used. We saw some of these in the hands of the Anauquás. On approaching strangers they shoot this arrow up in the air so that it will land somewhere near those they want to warn off. In its flight it produces a powerful whistling note which can be heard for some

distance and serves as a timely warning to the incautious. The Indians who planted this particular arrow in the sand were probably Suyás.

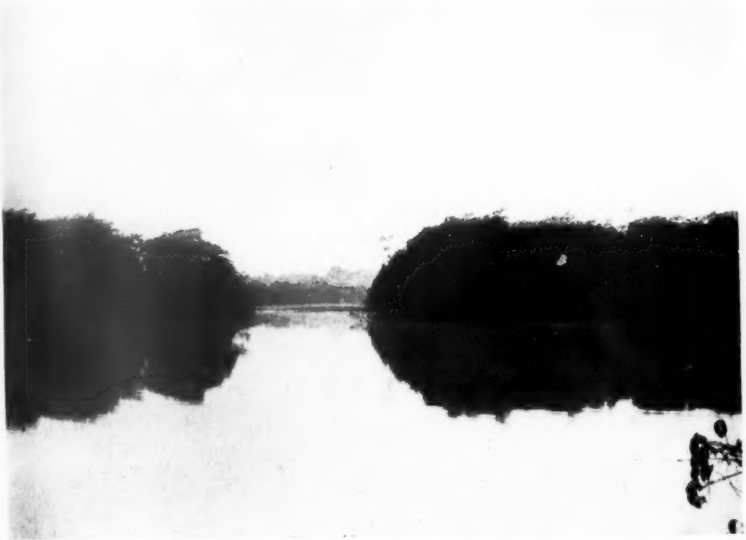
So far as I am aware only two written records exist of any one descending the Xingu in its entirety: that of the German von der Steinen, who made the journey forty years ago; and the rather brief story of a Brazilian naval officer called Fontura, who made it in 1916. Both these expeditions followed the Ronuro, which is the most westerly affluent of the Xingu. No one had ever made the through trip by way of the Kuluene or Kuluseu. Yet the following statement appeared in Rio and was circulated in the papers of America and Europe. It stated: "Commander Dyott's critics contend that he only followed the customary route which all travellers follow when going from the state of Matto Grosso down the Xingu river to the lower Amazon, whereas Colonel Fawcett left the beaten track for unexplored areas in the interior."

During the excitement of the past weeks, De Mello had been unable to get off any of the many wireless messages which I had written for our friends in New York. The Indian menace had been against our accomplishing much in this direction, and obviously we could not rouse our various amateur radio friends at any moment when it happened to be convenient for us. In consequence it was essential to stop in the middle of our flight and make a serious attempt to get through, though it caused us a delay of three whole days to do this.

The first night on the air, static was so strong that we could not break through even when working in the 20-metre band. The second night conditions were better, and about a quarter to twelve De Mello got in touch with the operator of General Rondon's expedition, which was then at Obídos, on the Amazon. Although the operator felt positive of his ability to relay our message to New York we felt that this could not be guaranteed, and it would be better to remain in camp yet another day. The next night we made immediate contact with our friend Mr. Abreu in Rio, the owner of amateur station 1—AW. To him we gave a hurried report of our position, which he passed on to the United States immediately.

When it came to making contact with England we were not so fortunate. We spoke direct with several stations close to London, but none of the operators would take a message for us. According to English law no amateur can receive or transmit messages by wireless, that being the sole privilege of His Majesty's Government. Although we were in a serious predicament from which we might never extricate ourselves, no amateur in Great Britain would do more than exchange pleasantries with us. They would not even pass on the vital news which we had to impart to the Royal Geographical Society.

When once we had disposed of our message to America our minds were at rest, and we could not afford to waste another day in idleness. If we were to move quickly it meant lighter loads in the canoes. The heavily loaded canvas boats were drawing too much water, and the only way to improve matters was to throw away some of our stores. Heavy "B" batteries, with many cases of oil and gasoline, were left behind. The large Cardwell transmitter and the small field set made by Silver-Marshall in Chicago, which had given such marvellous results, we retained. Ten thousand feet of motion picture film and three hundred rolls of Kodak film we threw ruthlessly into the river. Extra



Looking east over the Kuluene at the point where Fawcett crossed the river

Descending the Kuluseu: Aloique the third man from the bow

On the lower Xingu: passing through a side channel to avoid the main rapids

lengths of rope, much camp equipment, and our large rubber raft were amongst other things we reluctantly left behind in the forest.

It proved fortunate that we abandoned all this material when we did, because a day or so later the smooth tranquil river over which we had made such remarkable time was transformed into an angry torrent of cataracts and whirlpools. Countless barriers of rock barricaded the enormous river from shore to shore. Continually were we in danger of puncturing our canvas boats on the sharp ledges of rock which lay concealed beneath the water.

On the afternoon of August 23 our attention was attracted by a cloud of blue smoke ahead of us, and the blows of an axe sounded clear and distinct. The next instant a rubber-gatherer's canoe darted out and hurriedly scuttled off downstream, reappearing with six men instead of two, all displaying rifles. After some hesitation they pulled over to us and invited us to go with them to their headquarters, known as Porto Alegre, some 2 miles farther downstream. This was the very last outpost of civilized life on the Xingu River.

Although our safety was now assured, swift and turbulent rapids still lay ahead, but we now had local pilots familiar with the intricate channels to direct us. We reached Altamira on the lower Xingu on September 15, after a record journey. The canvas boats continued to do famously. This form of river craft had served me well in 1926, when I had descended Roosevelt's River of Doubt, and on this journey likewise they carried us safely for 1000 miles, transporting a truly formidable amount of cargo. In spite of numerous holes which got punched in the canvas by submerged sprags, their performance had been of the best. At the end of the trip I counted the number of repairs on my canoe. It had suffered most because it had always been in the lead, and it had eighty-four patches on the canvas.

That Colonel Fawcett and his companions perished at the hands of hostile tribes seems to me and to all my party beyond dispute. Amongst the fantastic legends which Fawcett had collected, there seems to be some grain of truth with a mass of fiction. It is hard to reconcile oneself to accounts of walled cities and miraculous lights shining in the jungle, but from what I saw I can well understand how such reports started and grew as they passed from mouth to mouth. As to a lost civilization, I can only say that the ornaments I saw amongst the Indians definitely indicate a culture new to South America. If I am right in this conjecture, which is shared by scientific people with whom I have talked, then the area I consider most promising for detailed search is that lying between the Xingu and Araguaya rivers. Any one attempting to penetrate this zone will have to go fully prepared to deal with several warlike Indian tribes. The Chavantes, Gayapos, and Suyás are all aggressive people, but offer a great opportunity for scientific study. Colonel Fawcett, steeped in the folklore of Matto Grosso, realized this fact.

In conclusion I must pay tribute to my four companions, who, ignorant of jungle travel, came through an arduous trip with so much credit. Unfortunately, space does not permit me to refer more than casually to their individual efforts. One and all put their best foot forward and so made a difficult task easier to accomplish. It was certainly discouraging at times, but they all proved staunch and loyal in their support from start to finish. For them it was a great adventure, and they came home better for the experience,

On the lower Xingu: passing through a side channel to avoid the main rapids

and none the worse physically for the hardships they endured. As for myself, I can only regret that I was unable to bring back the missing explorers or more reassuring news about them.

DISCUSSION

Before the lecture the PRESIDENT (Colonel Sir CHARLES CLOSE) said: Mr. George Dyott, who is to lecture to us to-night, is an Englishman who has travelled a great deal in South America. He has lectured twice before to this Society: on one occasion he gave us an account of railway routes across the Andes; and on another occasion he described air routes across the same mountain range.

Mr. Dyott has recently been on an expedition down some of the many tributaries of the Amazon, and among others he visited the Duvida river which is associated with the name of President Roosevelt, and I think is now known as the Roosevelt River. Mr. Dyott was led to take an interest in Colonel Fawcett's expedition, and he was enabled to trace its progress. We shall learn from him that in all probability the members of that expedition were killed by the natives. Mr. Dyott has much to tell us, and I must not occupy your time any more. We shall hope to hear from him what can be known of Colonel Fawcett's expedition, and I ask him to commence his lecture.

Mr. Dyott then delivered the lecture printed above, after which

The PRESIDENT said: The hour is rather late and I shall not, therefore, invite discussion. I am sure you will agree with me that Mr. Dyott has carried out a fine piece of exploration, and his account has come as, perhaps, a very necessary corrective to some lectures to which we have listened. It has helped us to realize that exploration has its serious side. The exploration carried out by Colonel Fawcett seems to have ended in disaster. Mr. Dyott has given us a clear idea of the country through which Colonel Fawcett travelled and the natives who live there, and he has shown us what was probably the end of that expedition.

I have a note which I will read with regard to Colonel Fawcett's end, but I should like to say, before doing so, that all who have been here to-night have very much appreciated the very admirable pictures that Mr. Dyott has shown. I do not think I have ever attended any lecture in which the country has been more beautifully shown than in the pictures we have seen to-night. He has described his experiences clearly and racily, and several times during the course of the lecture I felt almost as if I was in Brazil, and I dare say His Excellency the Brazilian Ambassador, who is present, felt the same.

The note I have made with regard to Colonel Fawcett is as follows: "This Society has for a long time past been anxious about the fate of its distinguished Fellow, Colonel Fawcett, and his companions. The matter has occupied the attention of the Council and of the staff of the Society, and was twice referred to by our late President, Dr. Hogarth. There seems, from what Mr. Dyott has said, to be, unfortunately, little doubt that the members of Colonel Fawcett's expedition have lost their lives at the hands of the Indians. We must deplore the loss of an adventurous explorer and distinguished geographer whom we shall never be able to welcome, as we had hoped to, and whose end will be mourned by all of us."

In conclusion, I wish to thank, in your name and in the name of the Society, Mr. George Dyott for a very admirable lecture.

THE GLACIAL CONDITIONS AND QUATERNARY HISTORY OF NORTH-EAST LAND: *continued from p. 470*

K. S. SANDFORD

7. The Edge of the Land-ice and the Coastal Ice-free Belt

The relationship of the borders of the North-East Land ice-sheet to topography can be judged from an earlier section of this paper (pp. 451–2), and the limits of the ice I have already defined in a map.* There is no need to cover this ground again, and we may now inspect the state of the ice at its margins.

I believe much of the ice on or near the north, west, and south coasts to be in a quiescent, though healthy, carapace stage. Marked activity is confined, as in the interior, to tracts defined by the subglacial topography, where the ice takes upon itself the features of a normal glacier as it approaches the coast. Unfortunately, the more important glaciers reach sea-level, and we have insufficient means of judging whether they are advancing, stationary, or retreating. Some project into the water, and the effects of tides upon those which are afloat have been described.

If the ends of the glaciers give us little information, the state of the ice immediately behind them affords us some guide, and for this the photographs taken from the seaplane in 1924 are invaluable. An almost continuous series from Lady Franklin Bay (near Low Island) to Mount Idun is available.† At the former two large glaciers reach the sea, where they branch round a rocky island. From the prevalence of crevasses, they may be judged to be in an active state. There is no reason to suppose that they are not normal glaciers draining from the main mass of ice, entrenched in rock valleys, and surrounded by highland ice through a large part of their course.

We come next to the barren rock of Great Stone Land (or Island), from which the ice retreated probably at a remote date (see pp. 545–550). The ice seems to have fallen back from Murchison Bay, though the northern sledging party noted a flow in its direction from the interior.

Ice enters the sea on both sides of the sledging base, and between this point and Mount Idun a great glacier emerges from the ice-valleys and amphitheatres crossed by the central party. It is torn by a multitude of crevasses and reaches the coast in chaotic condition. On the east side of Mount Idun another glacier, which I believe to be afloat, advances into Wahlenberg Bay Ice reaches the north coast of the greater part of Wahlenberg Bay. Near the head, between survey points G_1 and G_2 (see Fig. 3), is a true glacier which we may judge to be in an active condition for various reasons, including the steep flanks it presents to its rocky valley walls. It reaches the bay, but is not afloat.

The Eton Glacier has already been sufficiently described. It is active in its central, floating section, while it is dead and rotting where it abuts on Oxford Peninsula; it presents a steep lateral slope or wall difficult of descent on its south side at a distance of about 7 miles from its terminal face.

Leaving Wahlenberg Bay for the moment, we should note the carapace which crowns the promontory of Cape Selander, cut off from the main ice by

*K. S. Sandford, *Quart. Jour. Geol. Soc.*, 1928, *ibid.*, maps and pp. 662–664.

†See plates opposite pp. 460 and 464 in November *Journal* and p. 548 in the present number.

a rock valley recorded by Baron De Geer.* South of this an active stream of ice reaches the sea on the north side of Cape Torell, but it seems to be a local flow of the sheet itself rather than a valley glacier.

On passing to the south coast we reach the Rosenthal Glacier, which on most maps, including the Admiralty chart, is shown as a lobe of the main ice occupying a prominent position between Cape Torell and Ulve Bay. Yet in 1924 parties from the expedition's sloop walked about 5 miles from the coast in this district before they met the ice rising gently and unbroken before them. Carslake tells me that from this point he saw a tongue of ice running south-east towards the west end of Ulve Bay. This is also shown in a tele-photograph taken from the sea in the previous year by J. D. Brown. By combining all our records we can limit the width of the Rosenthal Glacier to a few miles at most.

In the region of Ulve Bay the distance that the ice lies from the sea is greater than was supposed, but on the east side it descends to sea-level or below it. Vibe Bay is an embayment of the ice-margin so far as we know, and the great Dickson's Glacier stretches to Cape Leigh Smith, a distance of about 100 miles, broken only by Isis Point. Dickson's glacier thus presents one of the broadest ice fronts known in the Arctic. The term "glacier" is inappropriate, since this vast wall is clearly the truncated end of the main mass of ice. If we judge by the absence or presence of crevasses we would not distinguish it as a region of active glacial movement (though crevasses abound near the ice-cliff itself). Moreover, there is a certain amount of evidence (see p. 455) that the front has fallen back a few miles in the last forty-five years, and this would seem to be supported by the absence of record of Isis Point prior to 1924, and by its completely barren surface. The region of Cape Leigh Smith has recently been dealt with by Commander Worsley's party and found to be much more involved than was supposed.† In all examples of supposed major retreats of the land-ice we must remember that previous records are scanty and usually unsatisfactory.

Lastly, turning to the north coast, we have no great body of information. Much of the coast is free of land-ice, though evidence of its former glaciation abounds. Observations made from the sea by the Oxford expedition of 1923‡ show that the ice-margin lies close to the shore east of Cape Platen, and that it sends out a number of short glaciers between knolls and hills of granite. They show, also, that Cape Platen is capped by a carapace which sends four short glaciers towards the sea on its east side, though none was seen on the west. Probably the carapace is still joined to the main sheet, occupying a position analogous to the Cape Selander ice but less markedly decadent so far as the "health" of the whole system is concerned.

No doubt glaciers find their way to the sea in Riips Bay, on the west side of Platen, but west of this the ice has retired to the top of the cliffs or inland by some miles, its margin being seen in this neighbourhood by the northern sledging party.

*G. De Geer, *op. cit.*, p. 11 and map. See also *Geog. Jour.*, vol. 66, 1925, upper plate opposite p. 133, incorrectly stated to include Cape Torell.

†*Op. cit.* See also Binney's remarks, *op. cit.*, pp. 25–26, on supposed retreat and advance of the ice along these shores.

‡R. A. Frazer and E. Relf, *Geogr. Jour.*, 64, 1923, pp. 193 *et seq.* See also 'Explanation of Plates,' *Quart. Jour. Geol. Soc.*, vol. lxxxii (1926), pp. 662–664.

In addition to the great glacial streams and glaciers there are, of course, numerous small glaciers which spill over cliffs crowned by the ice. Though many of these have pronounced snouts and clearly are active, they cannot be taken as criteria of the state of the ice as a whole. They are marked features in Wahlenberg Bay, one being prominent on the high ground north of Oxford Peninsula, and the glaciers which breach the precipitous cliffs on the south side of the bay may be placed in this class. The Selander carapace gives rise to similar glaciers which reach or approach the sea without advancing far into it.*

It seems but a step from such minor glaciers to the ice-slopes which lie on steep slopes and on screes below high cliffs. Their sole function seems to be to forward material which, falling upon them particularly during periods of high temperature, bounds and slides over their surfaces far beyond the limits of a normal scree. One may certainly look upon them as among the important agents in the formation of the huge low-angle screes which are characteristic of Arctic regions, and of more southerly lands formerly glaciated. I do not suggest that all these ice slopes are "slab-ice," *i.e.* detached remnants of glaciers which spilled over the cliffs before the margin of the ice retreated; many of them are obviously consolidated snow slopes.

We have gradually come to speak of a *retreat* of the margin of the land-ice, and we arrive at the much-debated subject of retreat and advance, growth or decay, of the system as a whole. We may summarize the evidence already given, mostly in other connections, in previous pages.

(1) From the disposition of erratic rocks and the generally subdued topography of ice-free surfaces, it is clear that at some time the island has been in a more advanced state of glaciation than now exists. To expose these erratics in high and isolated positions there has, then, been widespread retreat.

(2) By far the greater part of the ice-free surface has been exposed to subaerial denudation for a prolonged period, to be measured at the least in thousands of years. The interval has been sufficient for the surface to become profoundly modified. Valleys which are presumed to be of pre-glacial fluviatile origin have been re-occupied and their erosion by streams and rivers continued. A vast amount of frost-splitting has taken place, and the chemical decomposition of granitic and similarly resistant rocks, an infinitely slow process in high latitudes, has eaten deep into exposed surfaces and disposed of erratic material that lay upon them. The subglacial moulding of the topography is preserved, in broad outline, in the hard rocks of the north coast, but the detail is usually masked, and in softer rocks destroyed. In favourable localities an advanced association of slow-growing arctic plants is established,† and in all respects the signs of former glaciation have suffered severely.

(3) So far as we have seen, there is no evidence of a further and recent retreat of the ice on such a scale.

(4) The ice is locally active, elsewhere seems to be holding its own, and there is no evidence of the marked advance of any glacier. In certain localities

*Cf. De Geer, *op. cit.*, Pl. VI; and K. S. Sandford, *Quart. Jour. Geol. Soc.*, *ibid.*, Pl. XLVIII, fig. 2.

†V. S. Summerhayes and C. S. Elton, "Further Contributions to the Ecology of Spitsbergen," *Journal of Ecology*, vol. 16, 1928, pp. 211 and 256.

there has been retreat, but the ice does not show signs of widespread decay. It seems probable that a fairly slight decrease in general thickness would lead to the breaking up of a broad marginal zone of the north-western ice into separated plateaux and domes of ice such as are described from Edge Island.*

(5) In one locality known to me, the head of Wahlenberg Bay, there is evidence of a fairly recent retreat (probably advance and retreat) of the margin of the ice, with a zone of fresh boulder clay in front of dead ice. The same district gives us the relation of the ice and its movements to an important series

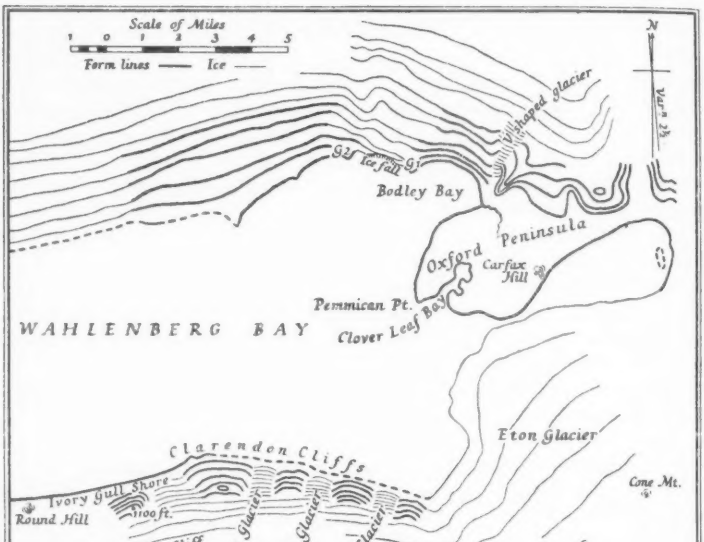


Fig. 3. Wahlenberg Bay

of raised beaches and associated subaqueous deposits, and accordingly we shall pay special attention to it.

Raised beaches are developed on the greater part of the ice-free coasts of North-East Land. They may be seen locally on the north coast, but are best displayed on the west and south coasts, where scores of small beaches, separated vertically by a yard or less, bear witness to long-continued and unbroken elevation of the land. The ever-changing shape of the shore-line and the growth of new beaches, spits, and islands are characteristic of North-East Land as a whole, and are beautifully illustrated in aerial photographs† taken between Lady Franklin Bay and Murchison Bay.

*N. L. Falcon, *Geogr. Jour.*, vol. 72, 1928, p. 138, appendix to paper by H. G. Watkins, "The Cambridge Expedition to Edge Island."

†Cf. 'With Seaplane and Sledge in the Arctic,' p. 64.

On the south coast, between Cape Torell and the west side of Ulve Bay (C. Lindeman), Carslake and Baker found the beaches rising steadily to 500 feet, with bones of whale lying upon them to about 250 feet. In Edge Island, not far to the south-west, Falcon (*loc. cit.*) recorded them only to 200 feet, which is the height to which I traced them at the head of Wahlenberg Bay, in the centre of North-East Land. One might be tempted to see some isostatic function in the difference, but a great deal more evidence is required to establish it.*

I am not confident that raised beaches occur on Isis Point, on the east coast, which rises to 150 feet and has a modern beach: definite information on this point would be valuable. If the rock has recently appeared from Dickson's Glacier, as seems probable, we should not expect to find high beaches there.

Turning now to Wahlenberg Bay, we find beaches to 200 feet on its south side, and they are there masked by old screes. Small glaciers descend over them to sea-level. It follows that if these glaciers had reached sea-level, as they now do, during emergence they would have prevented the formation of the beaches upon which they lie.

Passing to Oxford Peninsula, in the north-east corner of the bay, we find these conditions more strongly expressed. In the first place, the physical features above the raised beaches show every indication of subglacial moulding at some distant date, as described above. Lakes and tarns remain high on the hills in patches of glacial débris and old boulder clay (I am not convinced that any of them occupy true rock basins). Weathered erratic boulders abound on the highest hill (about 300 feet), which is draped with great screes, especially along the crags which are opposed to the central ice-amphitheatre of North-East Land. All the characteristics of an old glacial landscape may be observed. Below 200 feet raised beaches are plainly visible, and they may reach a little higher. These too have suffered from subaerial denudation at their greater altitudes, but they are continued in unbroken series, in some places, to the modern shore and mark the gradual elevation of the land. They contain shells below a height of 150 feet. The contour of the shore shows plainly that the upward movement has not yet been arrested.

Passing now to survey point G_1, a few miles to the west and on the north shore of the bay, we find glacial material which is associated with this elevation. This should not be confused with the modern débris deposited on land from the flanks of a glacier which descends to the edge of the bay near by, between points G_1 and G_2. The older glacial material forms prominent ridges of loose boulders set in a mass of clay, and here, at a height of about 180 feet above sea-level and buried in about 30 feet of clay, I found marine shells. Of these, many specimens of *Astarte borealis* were found in the clay, with the valves united, and with some of the epidermis still preserved, though the ligament was gone. As seen in the deep section there could be no doubt that the shells were in position of growth, and they were scattered through a considerable thickness of the exposure. Even more important was the presence of rare valves of *Mytilus edulis*, in fresh condition. The *Astarte* is still living in arctic waters, but I am assured by Mr. D. Baden-Powell, to whom I am

*Sinking of beaches towards the interior has been demonstrated in Klaas Billen Bay and Advent Bay in Western Spitsbergen (see J. M. Wordie, *op. cit.*).

indebted for the identification of the shells, that the specimens examined by him have a tendency towards a variety found in temperate seas. The same is true of the third species found here, a form of *Mya truncata*. Of these three the most remarkable is the *Mytilus*, which commonly lives between tide marks in temperate seas and cannot live in arctic waters where shore-ice is formed. It is well known in Spitsbergen, in raised beaches, but this is its first discovery in North-East Land and its greatest recorded height, so far as I know. The contrast it marks is the more vivid when we find that at the head of this bay parts of the ice-foot persist throughout the summer (1924), a thing almost unknown in Spitsbergen waters at the present day.

Lastly, on point G_1 near by there is a group of about half a dozen perfectly formed kames. Again they reach a height of nearly 200 feet, and they are themselves about 50 feet high. They are conical hills of smooth contour and flattened top, consisting of subangular slabs, pebbles, scratched blocks, and all the more solid elements of glacial deposits, and remarkably free of clay.

We have, then, evidence of the following: (1) the most widespread glaciation of the island was followed at some remote date by a marked retreat; (2) there followed an emergence of the land by at least 200 feet, of which certainly a part was accompanied by a higher sea-temperature than now exists, with an absence of shore-ice where it now persists longest; (3) during the emergence, however, some glaciers continued to flow off the land, as they still do, dropping clay and rubble into the water in which a temperate shell lived and arctic or sub-arctic species thrived. There is an abundance of evidence that the emergence is still in progress. This is a condition that might now be realized at the head of a northern Norwegian fjord into which a glacier flowed, but in which the water is saline enough to support the marine mollusca.

Finally let us turn to the most recently exposed boulder clays on Oxford Peninsula. In 1924 the Eton Glacier did not reach it, being separated from it by a channel barely 10 yards wide which joins the waters of the bay to a large lagoon, ponded between the peninsula and the glacier (see below). The end of the glacier seems to have fallen back quite recently, and where opposed to the peninsula, is lifeless, dirty, rotting, without crevasses, exhibiting every sign of decay. This is in strong contrast to the majestic ice-cliffs towering 100 feet above the waters of the central and deep part of the bay, only a few hundred yards away.

The side of the peninsula nearest to the glacier is covered with perfectly fresh boulder clay, which is piled to a height of about 30 feet above sea-level upon the raised beaches. The lagoon and its borders are choked with rubble and clay, and masses of similar red-brown clay containing blocks and boulders lie half concealed in the foot of the rotting glacier. The lagoon is an area of dismal lakes and tarns in fresh boulder clay. Observing it from the highest point of Oxford Peninsula, one feels that one is indeed in Pleistocene times and is looking down upon some such area as the Polish lakes in process of formation, with the rising mass of the Baltic ice still behind them. On the landward side (*i.e.* along the foot of the peninsula) great mounds of rubble have been piled to a height of 100 feet or more in a confused terminal moraine, but the greater part of the lagoon is a mass of the red-brown clay containing boulders, many of them striated.

Phot. K. S. S.

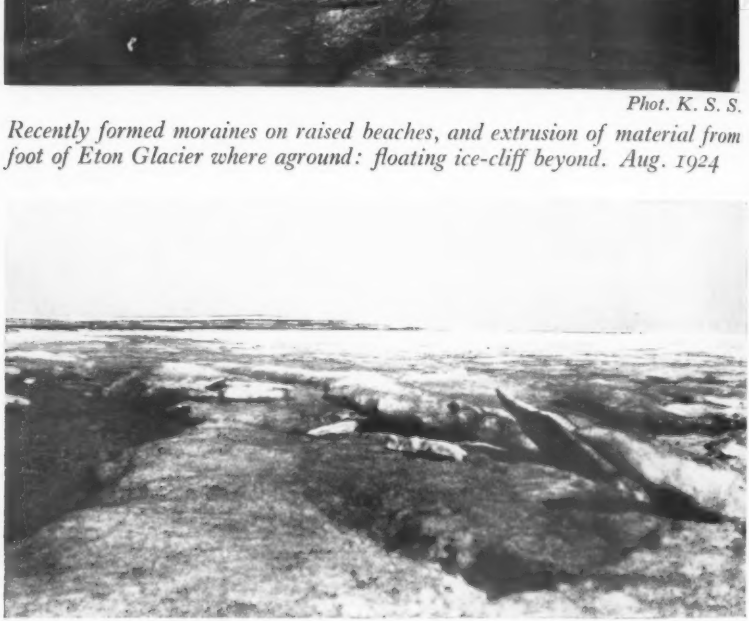
Kames in north-east corner of Wahlenberg Bay (Point G_1)

Phot. F. Tymms

Air photograph of raised beaches and tarns and modern fringing beach, with remains of ice-foot, near Shoal Point

Phot. K. S. S.

Recently formed moraines on raised beaches, and extrusion of material from foot of Eton Glacier where aground: floating ice-cliff beyond. Aug. 1924



Rafting-up of ice on shore with on-shore wind *Phot. K. S. S.*

Phot. K. S. S.

Removal of beach-shingle in spring by detached ice-foot (on left)

In calling this boulder clay I am aware that I arouse old discussions, especially as it is a true *moraine profonde*. But if a clay which is seen below a glacier, occupies a zone in front of it, and contains striated blocks and boulders, is not a boulder clay, we must assume that no such substance exists or give it another name. Its essential character is its subglacial origin; a little may be englacial (judging from the vertical ice-front near by), but, in common with all the main ice-streams in North-East Land, there is no surface moraine of any sort whatsoever.* Seeing that the country is almost completely inundated by ice this is inevitable. Further, the clay here contains erratics of which the parent rock is neither exposed nor does it exist in the vicinity (cf. gneiss of type seen on the north coast).

Evidence of the recent exposure of the clay and rubble is everywhere abundant. Its state of denudation is young to the extreme: the rubble is not in a state of repose, and slight disturbance lets loose a cascade of rock. Sun-melting of the interstitial ice which helps to hold it together has the same effect. The silence of the place is broken by the murmur and rumble of sliding rock.† There is no trace whatever of plant-life, a marked contrast to the old morainic surfaces of the peninsula near by which bear the richest flora in North-East Land.‡ Rutmarken§ and similar surface markings such as are seen on the old boulder clay and adjacent rock are entirely lacking.

In brief, there is not a single character indicative of long exposure to the air; long, that is, in the arctic sense, for we know that these processes are slow in high latitudes. It is impossible to say that the clay has been exposed by a marked retreat of the ice within the years of the present century or within as many decades.

[This paper was written abroad, with only my diary and certain other papers at hand. On returning to England and refreshing my memory of Nordenskiöld's book I found the following (p. 262): "In the proximity of the lower part of the bay (*i.e.* Wahlenberg Bay) some low granite hills projected out of the mass of ice at a height of 280 metres, and farther on were to be seen extensive moraines formed of clay and angular gravel. . . . I consider it highly probable that the moraines, like those on Axel's Island, have been forced up by the glacier, and that its border at this place is not receding but advancing." The position of the granite hills is known and is marked on my geological map (*q.v.*), and this is unquestionably that part of the moraine described above which is banked against the east side of Oxford Peninsula.‖ It appears that in 1873 the north side of the Eton Glacier front lay against the eastern side of Oxford Peninsula, with the moraine exposed in a ridge along the junction, as it is expressly stated that the moraine is "forced up." In fifty years the glacier has receded barely 100 yards near the centre of its course and about 2 miles on the northern flank. We do not know how much of the period has been

*The only surface moraine known to me is that near the sledging base, and that has been provided from subglacial sources.

†Glissading rubble on mounds of this sort becomes marked with arcuate scratches, which should be distinguished from true glacial striae.

‡V. S. Summerhayes and C. S. Elton, *Journal of Ecology*, 1928, *loc. cit.*

§C. S. Elton, *Quart. Jour. Geol. Soc.*, vol. lxxxiii (1927), pp. 163–194.

‖Axel's Island occupies a similar position to Oxford Peninsula at the mouth of Bell Sound, S. Spitsbergen, *i.e.* barring a large part of the width of the bay.

occupied by actual retreat. It would be interesting to know how much change the next quarter or half century will effect, and it is to be hoped that the glacier will be visited at intervals, as it is a sound indicator of the state of the ice in most of the interior of North-East Land.]

8. *The Shore-line and the Source of Icebergs*

To complete our review of the glacial condition of the island we must go to the present shore-line, which differs fundamentally from those of temperate latitudes, nearly every process working in reverse order.

Débris is brought to the shore from behind usually in spring and early summer, when melting gives rise to torrential streams. Even these do not behave normally, for at first they flow over deep snow and deposit upon it mounds of rubble which, with the melting of the snow, subside till they reach the true surface. Here they form false stream-courses, *i.e.* ridges of gravel and rubble which run without regard to the configuration of the surface of the ground, like miniature eskers. Often the rubble comes to rest upon vegetation, which it kills, and a layer of "peat" results. At the same time of year screes and piles of rubble which are not at their angle of repose may be set in motion and creep down to, and over, the shore, lubricated by the thawing of their contained water, and by mud.

When the snow has gone the top of the ground-ice may thaw also, and in any event a sea of mud usually marks the later stages of the annual melt, but thereafter the country becomes a dusty desert. These conditions are generally realized on the coasts of North-East Land known to us, but some of the elevated ground immediately adjacent to the ice-sheet does not seem to get beyond the mud stage before autumn freezes it up (cf. Mount Idun). Here, also, the intermittent blizzards tend to keep the surfaces supplied with fresh snow. Summer in North-East Land seems to be so brief that it might pass unnoticed between spring and autumn but for the melting which accompanies it.

Turning our attention to the seaward side of the shore-line, again we find almost everything working in reverse order. In the first place, in autumn the shore is beset with ice growing seaward and uniting with pack and flow or newly formed sea-ice. By the following spring the surface is buried deep in snow which exceeds the height of the beach. When thaw sets in the melting snow floods backward over shore and land as well as seaward. So far as the shore is concerned two features result (best observed on Low Island in 1924): (1) the water, plunging through any available gap, first thaws the frozen shingle and then scours out deep pits in it, the material being thrown up on the landward side; on Low Island these were of remarkable size, a man standing more than waist-deep in them; (2) currents of water run off the shore on to the land, depositing long streamers of shingle upon it.

Further than this, the beach is itself forced well above tide-level by the driving of great masses of floating ice which themselves may be pushed up its slope or may push the immediately adjacent ice up it. An arctic shore is accordingly above the level of flat land behind it, ponding back its drainage to form tarns (which must be distinguished from those resulting from actual elevation of the land). The landward slope of the shingle is considerably steeper than its seaward slope, and is commonly convex.

By such processes material which has collected along the tide mark in spring and summer is forced up and may be over the shore in winter, and left there in the following spring when the ice breaks up. On Low Island an enormous raft of seaweed from European waters had been so elevated and the shore was piled high with its rotting and stinking mass. With it were pine logs, brought to the sea by the spring floods of N. Euro-Asiatic rivers, and a fragment of an eighteenth-century boat. Relics from the Southern Seas are recorded from Spitsbergen, drifted northward by the Gulf Stream.* Large erratic blocks may sometimes be carried coastwise and finally forced over the beach.†

Finally, when the sea-ice breaks up, bay-ice or shore-ice in secluded parts of the coast breaks away and drifts seaward, carrying with it large piles of material deposited upon it as above. In particular it plucks away considerable masses of the beach itself and transports it to the open sea. This again was well illustrated on Low Island and its reefs.

Icebergs may be taken as signs of activity in a floating glacial front provided it does not retire by the amount which the bergs have removed from it. The central part of the Eton Glacier seems to fulfil this condition. It calves enormous floating masses of ice which encumber the head of Wahlenberg Bay. I have seen and photographed here tabular bergs of regular outline with 30 feet above the water-line, and older bergs, with more jagged outline, were much higher. All these were afloat and with a strong wind were driven from side to side of the bay.‡ Observation showed that there was little tendency for the bergs to escape from the bay into Hinlopen Strait. From the seaplane, however, large bergs were seen floating away from other glaciers, and it is evident that North-East Land supplies a considerable number to the adjacent seas. Whether it provides the enormous tabular bergs which are seen occasionally off its north coast remains a matter of doubt. One looks naturally to the east coast as their source, but those portions of the Dickson's glacier which have been seen at close range seem to be aground. None of the glaciers of the north coast is large enough to calve them, and one is inclined to look farther east than North-East Land for their origin. Noting their regular outline and vertical faces one would assume that they had not journeyed far, or at least that they are of no great age when they reach these waters.

9. *Summary and Conclusions*

In a paper published elsewhere the geology of North-East Land has been described and its essential influence on all but the highest parts of the land-ice is now illustrated. The highest parts of the ice, three independent domes, are controlled by meteorological factors which have already been discussed in this *Journal*. Although the effect of subglacial topography on the highland ice (*i.e.* the zone of predominant movement which borders the domes) is marked, and suggests that the ice is locally thin, there is an absence of nunatakkr.

The greatest amount of movement in the highland ice is along certain

*'Arctic Voyages,' 1879, p. 72. Summerhayes and Elton (*op. cit.*) also show the occurrence of raw rubber, drifted from ships torpedoed and sunk during the last war, fishing floats from Norway, and other material.

†Remarkable illustrations of this will be found in 'Report of the Canadian Arctic Expedition, 1913–18,' vol. xi, "Geology and Geography," 1924, p. 74 A.

‡For a description of this see 'With Seaplane and Sledge in the Arctic,' pp. 234 *et seq.*

valley-like depressions, where the ice has none of the major features of true glaciers but its surface is concave. The innumerable crevasses play the part of contours, spaced at regular intervals and bending up instead of down the valleys. Locally, however, whale-backed pressure hummocks, intensely serrated by networks of crevasses, are to be observed where the ice is most active in some of the valleys. Nearer the coasts normal glaciers develop in restricted areas, and there is also mass-movement of sections of the main body of the ice.

The supply of the highland ice is from the domes, radially by creeping of the ice and outward-blowing of snow. The intensity of fracture of the surface seems to depend on its angle of slope, which in the highland ice is governed ultimately by subglacial topography. Superficially, however, the slope of the domes or island ice is governed primarily by precipitation of snow and ice particles from the atmosphere.

The cold and heavy air which normally flows down from the higher parts of the ice attains, at times, high velocity; the resulting blizzards transport vast quantities of snow and ice to lower levels, and there is a tendency therefore to lessen the original slope. Melting, however, is of supreme importance in the encircling highland ice and seriously reduces its surface: probably then it tends to steepen the slope from the island ice, gravitational winds and melting thus having opposite effects upon the control of slope. Probably ablation is about equally active over the whole of the surface.

Much of the ice seems to be in a carapace stage, neither gaining nor losing appreciably, nor in active movement. Evidence from the marginal surfaces of land shows that the ice was once more widely distributed than now. Although still in the most advanced stage of the glacial cycle, it has passed its zenith.

We have no means of estimating the geological age of the inception of the land-ice, but one oscillation is clearly marked. This took place at a remote date and was preceded by the maximum extent of the ice: it was accompanied by the elevation of the centre of the island to some 200 feet. A continuous series of raised beaches bears witness to the uplift, still in progress. The glacial covering did not disappear during the oscillation, since kames and boulder clay are associated with the geater heights of the raised beaches. Moreover, *Mytilus edulis*, a shell of temperate or north-temperate seas, is associated with thriving arctic or subarctic shells in boulder clay dropped in water, pointing to sea-water warmer at the beginning of the uplift than it is to-day.

Recent boulder clay lies upon the lower raised beaches and marks a certain degree of local advance and more recent retreat. The boulder clay is essentially subglacial, with the erratics it contains. Surface moraines are lacking, owing to the absence of nunatakkr except on the very borders of the ice. Morainic material occasionally reaches the surface of the ice from below, presumably by overthrusting, where no solid rock is exposed. There is some evidence of local retreat of the ice borders in the last few decades. The system seems to be holding its own, retreating very slowly perhaps, and certainly not advancing.

The general mechanisms of the reverse order of shore-line deposition, by which material is elevated from the sea and piled on the land, and of similar effects of arctic conditions inside the shore-line, are briefly described. Certain glacial streams of North-East Land provide large icebergs, but they do not seem to account for the great bergs sometimes seen off the north coast.

ACROSS ARCTIC CANADA, 1925–1926

L. T. BURWASH

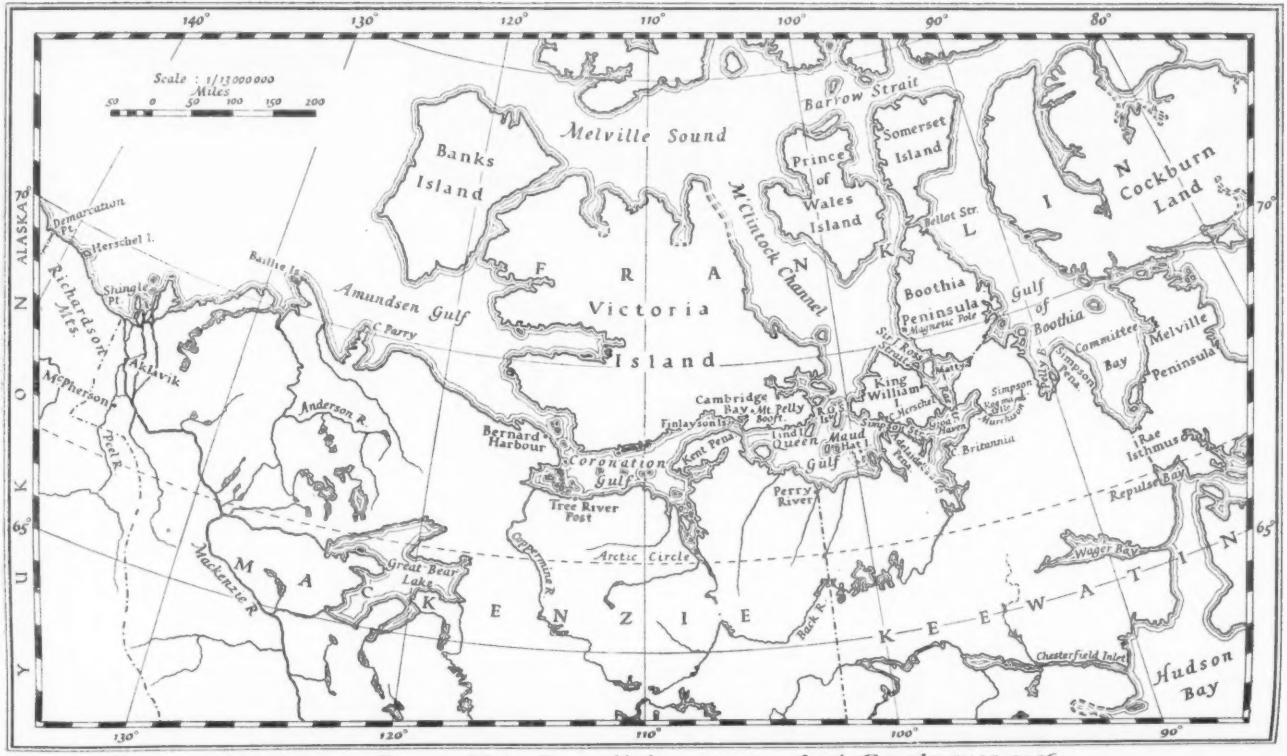
ON 14 July 1925 I left Edmonton under orders from the Canadian Government to make the trip along the Arctic coast from the Mackenzie delta to Hudson Bay, collecting economic, geological, botanical, anthropological, and other information en route. The details of the expedition were left to me.

Travelling by rail to Fort McMurray and then by the Slave and Mackenzie rivers, I reached Aklavik on July 31. Here, six days later, I embarked on a small schooner, and, proceeding in a north-westerly direction through the islands of the delta, we reached salt water after a twelve-hour trip. About 30 miles below Aklavik the last spruce and larch were passed, and some miles farther north, a short distance for the ocean, the last willows were seen. Along the coast the delta islands are low and flat, and are covered with green grass and huge piles of driftwood from the inland rivers. The Richardson Mountains rise along the western side of the Mackenzie delta, and their summits aid materially in the navigation of the intricate channels, sloughs, and islands between Aklavik and the Arctic coast-line. For the past few seasons the Northern Alaska–Yukon migration of caribou has swung into these mountains for the summer months, abandoning the pastures of the Old Crow River which for many years had been the summer grazing-grounds of the herd.

Upon reaching salt water the schooner was headed westerly, and about two hours later reached Shingle Point. Here I took my passage on the Hudson's Bay Company supply ship, S.S. *Bay Chimo*, which hoped to proceed as far east as Cambridge Bay. The harbour at Shingle Point will not take a boat of over 6-foot draught, the larger boats, such as the *Bay Chimo* which draws 18 feet, having to lie about 4 miles off shore. During the day a number of Eskimo schooners passed, sailing westward to Herschel Island. Many had come from points as far east as Baillie Island, and all were intent on reaching Herschel in time to trade with Captain Pedersen, whose ship was anchored at that point. The Eskimo of this area are among the most advanced of their race, with well-equipped schooners of considerable value. They are all trappers, their chief catch being the white fox.

On August 8 we left for Baillie Island, 450 miles to the east. The next morning a good deal of ice appeared, but not enough to interfere with the ship's progress. Baillie Island was sighted at noon, and two hours later we anchored at a point about a mile off shore. The settlement is on a very low sandspit between the south-easterly corner of the island and the mainland, the harbour being formed by the island, the sandspit, and the mainland. There are two entrances, one at either end of the sandspit, the northern one being the deeper. There is no fresh water at this settlement, both the Hudson's Bay Company and the police officials depending on fresh-water ice, which, after being hauled from the mainland, is stored in barrels and tanks and allowed to melt as summer progresses. This was originally an old-time whaling station where, prior to the advent of the police and traders, the water supply would be brought in on shipboard.

The country round the post supports a very considerable native population.



Sketch-map to illustrate Major Burwash's journey across Arctic Canada, 1925–1926

It produces on an average probably more white fox pelts per hunter than any other Arctic district either east or west. This may to a certain extent be due to the skill and ability of the trappers themselves, who rank among the best of our Eskimo population. Many of the natives are comparatively well-to-do, speaking English well, and cases of destitution are uncommon. This island marks the eastern limit of what may be called the western influence on the native population. From Demarcation Point to Baillie Island the native customs and styles of dress and ornamentation are very similar. Noticeable among these is the old custom, now discontinued except by a few old men, of wearing labarets made of ivory, bone or stone and inserted in a slit cut in the lower lip. The modern influence of the West is strongly marked, the people being much more advanced in business ideas than those to the east.

When we left Baillie Island on August 11 the weather turned dark and cold, with light snow in the air, and about midnight, off Cape Parry, heavy pack-ice was encountered, which necessitated a somewhat lengthy detour. Bernard Harbour, reached next day, is well sheltered and will take ships of 20-foot draught. The settlement consists of the Hudson's Bay post and an Anglican Mission, all the buildings being quite small. There were three white men, two white women, two white children, and many Eskimo here. The natives, as at Baillie Island, appear prosperous and contented.

The 400 miles of coast-line from Bernard Harbour to Baillie Island was for many years a barrier between the two main groups of Canadian Eskimo. For many generations, until the advent of the white men during the first decade of the present century, no intercourse was held between these settlements. While much has been done during the past fifteen years to bridge this gap, the differences between the two groups are still most apparent. The people in the Bernard Harbour area to-day include the original native population and many new-comers who formerly lived in South-West Victoria Land, but who, on account of the shortage of game, have moved over to the mainland.

We reached Tree River early on August 15, the ship anchoring immediately in front of the post buildings. The harbour is large and well protected, the land rising to a considerable elevation on all sides. Close on shore, however, there are shoals and trouble is sometimes experienced in lightering supplies to the post. Tree River consists of a Hudson's Bay Company post and a Royal Canadian Mounted Police post. The population at the time of our arrival was seven white men—three Police and four Company employees. The low swampy nature of the site has driven the buildings to the tops of two small rocky knolls, which are windswept during the winter, making the buildings anything but comfortable.

The Eskimo of the Tree River area are not very numerous, and differ little in appearance from those at Bernard Harbour. The various native communities on Coronation Gulf, while carrying distinctive tribal names, are in no way strangers to each other. During the sealing season they frequently travel in mixed bands, separating when the time arrives to set out for their summer hunting grounds. The Tree River area is not considered particularly productive of either caribou or foxes, although during the season 1924–5 the latter were quite plentiful. The sea produces the greater part of the native food, both fish and seal being taken in sufficient abundance during

Sketch-map to illustrate Major Burwash's journey across Arctic Canada, 1925–1926

certain seasons of the year. The area south of Coronation Gulf is known to contain extensive mineral resources, especially large copper deposits, but there is no possibility at present of these being profitably exploited. The more valuable resource of this area, from a local viewpoint, is the spruce timber some miles inland, from which the coast natives draw a considerable part of their wood for sledges and implements.

We left Tree River for Kent Peninsula on August 17, passing many islands, the channels between some of which are shallow, but as the ocean-bed is soft clay a ship drawing 18 feet can get through, though not without touching the bottom. At Kent Peninsula we anchored 7 miles out owing to shallow water. The country here consists of low grass-covered hills, the rock *in situ* being archean. The native population is comparatively large owing, no doubt, to an abundance of caribou.

Next evening we anchored at Cambridge Bay, about half a mile from the post, but during the night a hurricane developed which drifted the ship out towards the mouth of the harbour, a distance of over a mile, in spite of the fact that there were two anchors down and that the ship was steaming against the wind. The Company post consists of a small one-room house, and smaller store, the native watchman, Keegapoo, living in a tent with his wife and child. In addition to these three natives, there were about twenty sleigh dogs which had been sent over from Kent Peninsula during the late spring as the abundance of fish at this point solves the dog-food problem. Here I took up my quarters in the Company house with a Kent Peninsula Eskimo who had also come ashore from the ship as my companion.

Cambridge Bay marks the eastern limit of the white influence, the only sign of contact with traders among the people beyond being the firearms which have largely replaced bows and spears. From Cambridge Bay the south-east corner of Victoria Island appears low-lying and desolate, broken only by Mount Pelly, an elevation of about 600 feet lying to the north-east. There are many lakes and streams, some of considerable size. The prevailing rock was limestone, little or no rock of igneous origin being found even in the drift. The greater part of the country is overlain by bluish clay varied by broken limestones. Only at one point was rock *in situ* seen.

The harbour is some miles in extent and has ample water for boats of 18-foot draught, although when passing the Findlayson Islands shortly before entering the bay, the water had shoaled rather ominously. Inside, however, ships are well protected from the sea, but the low-lying land gives little shelter from the violent winds which are by no means uncommon. No land mammals were seen, but there were fair indications of fox and lemming. Before the natives deserted the area they considered it a good trapping district. The waters of the bay and coast are fairly well stocked with jar and square-flipper seal, but no white whale were seen. The fishing in the lakes and streams is excellent, the most productive season being late September, immediately before the freeze-up.

Before the departure of the *Bay Chimo* the exact local time was secured and a meridian established on shore. This, with the observed position of Cambridge Bay, was the zero used during the following winter. During the last few days on board the weather had undergone a decided change, a feeling of autumn, with winter at no great distance, having crept into the air. The sky

was bright, but there were chilling north-westerly winds on most days. On August 23 I went up the stream which enters the northerly end of the harbour with the two Eskimo. Following the stream a short distance inland we reached a point where the natives had constructed a large stone fish trap. Upon being overhauled it yielded fifty-four salmon. The fish traps constructed by the local Eskimo are very ingenious. A shallow section of stream is selected in which a low stone wall of some length is built parallel to the shore. At its upstream end a circular pool is walled in, only a small opening being left through which the fish may enter. In the downstream wall of the pool long narrow inlets are constructed into which the fish go when the fishermen disturb the water and from which they are unable to retreat, as not enough space is given for them to turn. The fisherman has then only to take his fish out by hand.

Next day a trip was made westerly along the coast, the harbour being crossed by canoe. The country is of low limestone with very little rock *in situ*. Some plants were secured and numerous old camp sites seen. These, however, yielded no specimens of implements or other native products, as they were all located on barren ridges upon which no new soil had been formed, and anything that may have been left there in the past had either been picked up by the natives or carried away by the wind. The country is dotted with small ponds and lakes which appear to have been the breeding-grounds of several varieties of duck, as every lake had flocks of young duck just ready to fly.

The site of the winter camp used by Colliston during the winter of 1855 was also visited. The only indication of the buildings now remaining is the stone foundation of the house.

On August 30 two schooners arrived, the motor-driven *Fort Macpherson* and the *Elsueno*, the latter, dependent on sail alone, in charge of Peter Norberg, who for the two previous years had been representing the Hudson's Bay Company on King William Land, where he and his schooner had wintered. Three days later the *Elsueno* left for Tree River, and the *Fort Macpherson*, in which I travelled the next stage of my journey, for King William Land. The weather was very fine, and it was hoped to run day and night, although the darkness now lasted some hours.

We anchored next day off Lind Island, which consists of several low rolling limestone hills, with comparatively little vegetation, and is useful only as a monument marking the eastern entrance of Queen Maud Gulf. No signs of native occupation or wild life were observed.

The Royal Geographical Society Islands, which were next reached, extend approximately 20 miles east and west and 50 miles north and south, and consist entirely of low flat tables of limestone. Even before the group was sighted from the deck many reefs similarly formed were crossed, some rising to within 6 feet of the surface. The islands themselves appear to have only shallow channels between them, no channel for a boat drawing more than 6 feet having yet been located; in fact, the whole of Queen Maud Gulf appears to present a difficult problem in navigation. The ocean bed is of flat limestone, with reefs rising at many points to within a few feet of the surface. No high land was seen except on an island lying far to the south-eastern corner of the group which, on account of its silhouette, has been named Hat Island.

On the Islands themselves there are many small lakes and ponds, with a fair proportion of the land area covered with grass, and they should serve as a good breeding-ground for certain types of waterfowl.

The ship anchored off the easterly end of Hat Island in a harbour well protected by reefs and small islands. The island consists of flat beds of limestone which rise to possibly 100 feet in the centre, the land closer to the coast being low and flat. Caribou signs evidently dating from the previous spring were seen, and many fresh fox tracks in the fine sand along the coast. Vegetation was not very abundant and life, with the exception of wild duck, comparatively scarce. A few square-flipper seal were seen at Cambridge Bay and again here. Many signs of former native occupation were noticed, stone caches, evidently for caribou meat, being numerous, while the higher land appears to have been used as a burial-ground. Soapstone vessels and various implements of bone, stone, and native copper were collected.

Magnetic observations were taken here, but were only approximate. It should be remarked that the ordinary ship's compass does not work east of Coronation Gulf, but the fine trough compass supplied with the transit could be relied upon.

At King William Island we were met by the one resident, Mr. John Livingstone. He had arrived on the first trip of the *Fort Macpherson* two weeks earlier, and had remained alone in charge of the merchandise caches. He had neither seen nor heard of any natives. For some years they have not used King William Island as a summer hunting-ground, Boothia Peninsula, Adelaide Peninsula, and the interior on the mainland south of Queen Maud Gulf being more attractive fields. Towards the eastern end of King William Island several streams flowing from fresh-water lakes are well stocked with fish, but the absence of caribou in summer would leave Eskimo living there during the season destitute of winter clothing. For many years the local natives have not hunted sea life during the season of open water, a fact, no doubt, due to the uncertainty of summer ice conditions and the difficulty in securing wood or other material from which to construct seaworthy kayaks. During the crossings of Queen Maud Gulf, between August 18 and September 1, enough floe-ice was encountered to render sealing along the coast of King William Island impossible. On the second trip between September 2 and 5, no ice whatever was seen. This appears to be the first occasion on which such favourable conditions have been reported.

The first impression given of the coast of King William Island is one of almost complete desolation: expanses of clay interspersed with drab and broken stone, varied by ancient sea beaches of clean-washed gravel, monotonous in their regularity. Closer inspection however reveals rough grasses and many of the hardier arctic flowers, while the lemming, fox, and caribou have held their footing, the caribou during the summer season only, but the lemming and fox throughout the year. Many types of land and water birds visit the island during the short summer season, but these find a home elsewhere during the harder winter months. Some of the streams and lakes support several varieties of fish, while the salt water along the coast is well stocked with both fish and seal.

The interior of the island presents a warmer and more hopeful picture.

Vegetation is much more plentiful and vigorous. The country still consists of clay, broken stone, and wash gravel, but where the cold sea winds no longer prevail, the hardy plant-life of the north entrenches itself in all but the more exposed areas, and animal and bird life quickly follows. Traces of human occupation are also to be seen—stone topek or tent rings, meat and fish caches, and Eskimo graves—all evidence of many years of activity by the native hunter.

The only signs observed of the advent of white men were three cairns on headlands along the south coast of the island, one at Cape Herschel (latitude 68° 41′ N., longitude 98° 22′ W.), left by Simpson in 1839, one on a headland 20 miles east of Cape Seaforth, established by C. F. Hall about 1869, and the last on the eastern side of the entrance to Gjoa Haven, marking the point where Amundsen and his party wintered during 1904–5. Rasmussen, who reached King William Island during the spring of 1923, built a Greenland dugout on the western slope of Cape Seaforth, where the excavation, with its caribou-skin lining, is still to be seen, while later in the same season Peter Norberg established a small trading post for the Hudson's Bay Company, which is still occupied. This post, at the time of our arrival, consisted of only two buildings, one a small store built of sheet iron, the other a double-canvas house which was used as a residence.

Shortly after the schooner anchored in the bay opposite the King William Island Post, Mr. W. Gibson, the relieving agent for the Company, and the writer, took up quarters on shore, as this was to be our home for the winter; the others, who were destined for a point on the south coast of Queen Maud Gulf, remaining on board. On September 7 the weather became very unsettled, and during the following morning the first heavy snow fell, covering the ground to a depth of about 4 inches. This however lasted only a few hours, as a quick rise in temperature dissipated the greater part of it. It had been my intention to put up a double tent for winter, and for this purpose I had bought a small supply of rough lumber, but eventually this was used in the construction of the caches and an arrangement made for me to live with Mr. Gibson in the canvas shack already erected.

The *Fort Macpherson* sailed for Parry River on November 12, but a fortnight later she returned to the post, her skipper reporting that inclement weather had prevented him reaching his objective, and that it was his intention to winter with us. This necessitated building winter quarters for the crew of the schooner, which occupied all hands for some days, the camp then settling into winter routine. It was my intention to remain at this point until early March. The following five months were spent in making short trips over the country, in building sledges, and during the latter end in conditioning ourselves and our dogs for the long and arduous trips that were planned for the following spring. By October 12 the fresh-water lakes had all frozen solid, and on the 13th the salt water was freezing quickly. During the day the first natives appeared. They were camped on the opposite side of Simpson Strait, and were awaiting solid ice to allow them to cross to the post. This they were able to do on the following day. This day also saw the first blizzard.

Until November 12 the only natives seen were two families, both of which had spent the preceding summer within a short distance of the post. The first

to arrive—a man and his wife and two children—had spent the previous three months on Adelaide Peninsula; the other, an older man with his wife and one child, had summered on the eastern end of King William Island, where they lived on an unvaried diet of fish. Both families built permanent igloos close to the post, one man undertaking the duties of post servant, the other electing to fish and trap in the vicinity of the post. On November 23 four more families arrived, coming from the main sealing camp of the Netselingmeuts, then on the ice some miles south of Rae Strait. These families had hunted during the past summer on Boothia Peninsula near Cape Britannia, and reported a successful season with plenty of caribou, fish, and a few musk ox still in their caches.

All of the natives seen thus far were physically much above the average for their race. Muscular men and women comparing favourably in stature with white men, with clear skins and clear eyes, every appearance of perfect health, and with every confidence in their ability to obtain from the country a living for themselves and their dependants. The only valuable commodity which they produce in any quantity is the pelt of the white fox, but in planning their winter campaign to secure these they appear to limit the prospective catch to just enough to secure their outstanding necessities, trusting to the surplus of seal meat or fish secured in the routine of their everyday life to supply a medium of exchange with which to meet their minor wants.

None of the natives seen so far appeared to know anything of the Franklin party. They came from Boothia Peninsula and were not the tribes to see the Franklin party on the march. The King William Land natives, who did encounter this party on their last march, had all moved westward to the south shore of Queen Maud Gulf. So far none of these had visited the post. The Boothia natives, however, spoke of a large boat covered by water somewhere in Ross Strait, but knew nothing of its origin. They stated that the east coast of King William and Matty Islands had long been a source of supply of iron and wood, this being found cast up on the beach. From implements in their possession the wood thus secured appeared to be heavy hardwood similar to that used in ship's fittings or heavy casks, while the iron was undoubtedly once used as barrel hoops.

It was not until December 4 that the first natives from the west visited the post. This party consisted of a young hunter with his two wives and one infant child. Physically they appeared to be quite the equals of the Netselingmeuts, having manifestly taken full advantage of the hard native training. Their clothing showed more desire for ornamentation, and their accoutrements a much closer contact with the white trader. Their summer had been spent far inland to the south of Queen Maud Gulf, but while caribou had been plentiful then, the major part of their hunt had been made so far from the coast that no great quantity of meat could be brought to their winter quarters on the salt water ice. The sealing had been very poor, leaving them almost destitute of fuel, while for food they had so far depended on fish which were none too plentiful. They had, however, trapped a number of foxes. Later two young natives, little more than boys, arrived from the seal camp to the east, bringing frozen meat and fish for the use of several quite old natives who had taken up winter quarters near the post.

On September 14 daylight lasted about three and a half hours. While the sun did not show above the horizon, for some time before and after noon the southern sky was filled with the most wonderful colours. A week later the weather was still cold, with high winds and flying snow, which in no way invited travel or outdoor work. The day after Christmas the shortage of fresh meat and fish was relieved by two Netselingmeut natives, who arrived from the isthmus of Boothia bringing a supply of both, which they were glad to exchange for tea, sugar, tobacco, and other white man's commodities.

The continued storms had made a great difference in the appearance of the settlement. When the snow had drifted hard enough both houses were built over with blocks until a wall and roof of about 2 feet in thickness covered the buildings. As the winter progressed the drifts around the buildings rose higher and higher until by Christmas a 40-foot tunnel, with rooms cut on each side for the storage of coal and other supplies, was necessary to connect the houses with the outside world. The only indication of the lower house showing above a field of level drifted snow was about 1 foot of stovepipe and the top of the ventilator. From the New Year until spring each succeeding storm called for a fatigue party either to clear the entrances to the house or to extend the tunnel to the open air, until by April one tunnel had reached a length of 80 feet. It was also necessary to excavate openings to our window, although by mid-winter the amount of light thus admitted had, even at noon, to be augmented by lamps.

About the New Year several more native families from the south coast of Queen Maud Gulf arrived bringing a fair number of fox pelts. For ten days the weather varied from fine to hopeless. Native hunters were visiting the camp more frequently, the whole Netselingmeut community having followed the seals westerly from Boothia Peninsula and was now camped much closer to the post. January 11 was a clear day and marked the return of the sun. It was not visible from the coast, but lighted the higher country inland for a few minutes at noon. No one who has not experienced the complete absence of sunlight for a fairly lengthy period can properly appreciate what this annual return of light and hope and warmth means to the people of the North.

The following seven weeks passed without any outstanding event, much of the time being spent in the construction of a new sledge and in repairs to another, the making of dog harness, and in the selection and repacking of a travelling outfit. Native visitors were more numerous, many of them remaining some time near the post while they augmented their food supply by fishing through the salt-water ice for cod. An examination of the holes cut for the above purpose showed the ice in Simpson Strait to have a fairly uniform thickness of about 58 inches.

On March 21 I set out on a visit to the Netselingmeuts at their several sealing villages scattered on the ice between King William Island and Boothia Peninsula, intending also to establish caches for use when later in the season we would travel to Repulse Bay. The expedition now consisted of two sledges, two natives, nineteen dogs and myself, a third sledge with part of our load having preceded us by one day. We hoped to reach the settlements in four days, but it was nine before we reached our first objective. One of the natives had a caribou cached at a point along the coast, which helped to keep the dogs

on their feet, but by the time the native camp was reached they were sorry-looking teams.

The weather the first day was clear, but the temperature quite low, the minimum during the day being 30° below zero. The trail was very good and, considering the weight of the loads, the day's run had been excellent. Next morning we were awakened by a howling storm, and we were not able to move on till the morning of March 8, when the weather had improved. It was still cold, 24° below zero, but the little wind blowing was from the west and consequently in our backs. We passed Todd Island shortly after noon. A few miles north of this point was Gjoa Haven, the harbour in which Amundsen and his party spent two winters (1904–5) during their trip through the North-West Passage. An igloo was finally built about 6 miles beyond Todd Island, where we camped for the night. The dogs, who were showing signs of the lack of food, were given a ration of dry rolled oats as a substitute, though a poor one, for the raw meat to which they were accustomed. During the following night they raided our cache, eating or destroying 10 pounds of rolled oats, some sealskin boots and fur clothing.

We reached the seal-hunter's camp, which lay 2 miles to the south of our course, on March 12. Here we found fifteen large igloos which housed the greater part of the Netselingmeut tribe. We were welcomed in the true Netselingmeut manner, the men first standing in a group at some little distance while the women of the settlement who were mothers, each with a knife in her hand, ran round our loaded sledges in a wide circle. According to their belief the track left by the women would encompass any evil spirits that had followed us across the ice, thus keeping them out of their settlement. After this formality had been observed the men advanced to greet us. As they showed every inclination to be most friendly and helpful, two circles indicating the size and position of the igloos we would like were marked on the snow, and within an hour thay had erected for us a large and fairly comfortable home. Our share in the proceedings was now clearly indicated, so the primus stoves were lighted and kettles of tea and rations of hard tack produced as quickly as our domestic arrangements would permit, after which every one was given a pipeful of tobacco.

The village was the fourth of a chain that had been built by this band, the others, as the sealing failed or better locations were found, having been abandoned. These natives had spent the winter in the usual uneventful way and had met with fair success in their hunt, securing enough seal to provide sufficient oil for their lamps, but much of their food had been drawn from their meat and fish caches on Boothia Peninsula. Many of these caches had been built shortly before the freeze-up when both caribou and fish were plentiful, but others consisting of dried meat and dried fish were the result of the previous summer's hunt. They informed us that they seldom used their rifles on the autumn caribou hunt, as the animals could easily be killed with spears while they were fording streams or lakes. Many of the men, although possessing a rifle of sorts, were still equipped with bows and bear spears, with which they said, should their ammunition fail, they could support themselves. No difficulty was found in purchasing seal, frozen fish, and rancid caribou meat, so the famine amongst our dogs for the time ended.

A week was spent in this settlement, the ordinary daily routine of the native being followed as far as possible. At daylight the hunters would scatter over the ice accompanied by a dog on a leash whose duty it was to locate the seal holes. When one of these was located it was first carefully examined, a long slender probe made of caribou horn, or, should the hunter be more advanced, of heavy iron wire, being used to find the exact centre of the opening in the ice, which lay two or more feet below the surface of the snow. In this operation great care must be taken not to disturb the snow more than is necessary, as an unusual amount of light would spoil any chance of the seal using that particular breathing-hole. Each seal keeps a number of these holes open, and appears to visit them more or less in turn. After these preliminaries are complete a wind break is built of snow blocks, and the hunter takes up his position, his spear always in readiness to await the coming of the quarry. This may involve a wait of minutes or of many hours.

During the evenings as many as could crowd into our quarters presented themselves, and were made happy with tobacco, their contribution being tales of the country and its people. From them I heard much of the ship which lies on a reef off the east coast of Matty Island, and which can scarcely be any other than one of those abandoned by the Franklin party. They all agree as to its location and appearance, and state that the coast-line in its vicinity has long been productive of both iron and wood.

Upon inquiry I learned of two other smaller native communities, one camped to the south near Cape Britannia and the other near Rae Strait. No recent communication had been had with either of these villages, so their exact location was somewhat in doubt. I decided to push on to the mainland of Boothia Peninsula and to establish a cache of dog food and other necessities at some point inland from the mouth of Murchison River, where it would be of use on the trip from King William Island to Repulse Bay. A native who had hunted and fished on the Murchison River in the preceding autumn, was willing to sell both caribou and frozen fish which he had cached at a point on the river known as Kog ma telle, so he and his dogs joined our party and we left the Netselingmeut village on March 19. We had decided to follow the line of abandoned villages which would bring us ashore at a point some miles north of the mouth of Murchison River, this route being considered preferable as the direct route was said to be through rough ice for the greater part of the way. Some trouble developed in making use of these old camps, as at the time their builders left them many fox traps had been set which, while they did not appear to have gathered many foxes, were much more fortunate with our dogs.

After two days we reached the coast of Boothia Peninsula, our first close view of land in eighteen days. Life on the sea-ice had differed very little from that ashore, the only disturbing incidents being the groaning and the cracking of the ice when abnormal pressure, due either to tidal currents or wind, developed. Only one authenticated story has reached me of an ice crack opening across the floor of an occupied igloo. This was experienced by Mr. Hunter, an employee of the Hudson's Bay Company, when travelling in the vicinity of Repulse Bay. Our landing on Boothia was made at the autumn rendezvous of the native hunters returning from the summer hunt, which is

also the point where the community leaves the land to take up its winter quarters on the ice. Here we found only one large igloo which must have housed not less than seventy-five people. It appeared to have been developed piecemeal as the hunters with their families congregated, each newly arriving band building against the structure already on the ground and afterwards cutting out the wall between the old and the new. The total length of the igloo as we found it was about 65 feet, with a breadth of 24 feet. As it was impossible to heat so large a building, one corner was walled in and a comfortable night spent.

Next day, after two hours' travel parallel to the coast-line, we reached the mouth of Murchison River, and then turned up the river. A cascade occurs at the point known as Kog ma telle, about 15 miles from the mouth, and marks a fishing ground favoured by the natives during the early autumn. The meat and fish we were taking over from the native with us being cached here we decided to camp, and make the cache of supplies to be used on the trip from King William Island to Repulse Bay. Four of the caribou which we had hoped to purchase were found to be covered with ice to a depth of 8 feet formed by water seeping from the hill above, and were not available.

The section of the western coast-line of Boothia Peninsula visited by us consists, like King William Island, of limestone and clay, with comparatively little rock *in situ* showing. Near the mouth of Murchison River there are large sand flats with drifted sand covering sections of the sea-ice, this drift in places being heavy enough to give the impression of sand bars. The entrance to the salt-water inlet into which Murchison River flows is concealed behind a group of low islands, and may easily escape notice unless the landmarks, which are none too conspicuous, are known. Eight miles up the Murchison River the formation changes to archean, the country rock consisting of gneiss with much rock in place exposed, the cataract at Kog ma telle occurring with the narrowing of the river's channel between massive rocky banks. The river itself is not navigable even for small canoes, the wider stretches being so thickly filled with boulders as to give an easy crossing by stepping-stones. The surrounding country is, in season, very rich in fish and caribou, and musk ox are occasionally found. As a fur area it is almost unexploited, yet the indications of white fox were more numerous than in any other part of the North which I visited. Lemming were plentiful, and the first warm sunshine brought out many marmot. At the time of this visit to Boothia no sign of the forerunners of the spring caribou migration were seen.

On March 24 we turned towards King William Island. Following the Murchison River down to its mouth, a direct course was struck to the first sealing village. Here we found that about half of the natives whom we had seen on our previous visit had gone elsewhere, some to join a new sealing camp near Todd Island, and others northward to a similar venture in Rae Strait. The natives were most anxious that we should remain with them for a time, visions of tea and biscuits no doubt floating in their minds; but time was beginning to press, so our stay was limited to one day. We now made for Todd Island, where we were given to understand quite a large sealing camp had been established. A native accompanied us, driving a light sledge which proved too fast for my teams, which were fairly heavily loaded; so I travelled with him,

leaving the others far behind. The village which we reached that night had sprung up since we had passed earlier in the month, but it had already assumed very considerable dimensions and the igloos were large and well built. The sealing in the immediate vicinity had prospered, and this, with the steadily increasing daylight, had a marked effect on the spirit of the community. I learnt that the natives congregate at this point annually, and it is from here that they scatter to their various summer hunting-grounds.

Three more seal, for the dogs and use at the post, were secured, and on March 29, accompanied by a third native and his dogs, which were rendered necessary by the acquisition of extra dog food, we proceeded towards King William Island post. With lighter loads we could have reached our journey's end in one day, but as it was the journey took two days. All the dogs had quite recovered from the effects of short rations during the early stage of the trip and appeared to be in fine fettle, but the first news that greeted us on our return to the post was that an epidemic of dog sickness had broken out. We therefore decided to re-outfit with all speed and get our teams out of the post as quickly as possible.

It was not until April 5 however that a start could be made for Repulse Bay. We reached Todd Island on the following evening. Next morning two of the best dogs were ill, and they died during the day. After two hours' run from the sealing camp along the south-east coast of King William Island, Gjoa Haven was passed, the only visible indication of the Amundsen party being a cairn on the eastern headland. The sealing camp in Rae Strait proved to be a settlement quite as large as that at Todd Island, with many strange faces. These people hail from the isthmus of Boothia and farther north, many of them never having visited the trading post and seldom the more southern sealing camps.

During the night more sickness developed among the dogs, three being found dead in the morning. Anticipating a further loss, five new dogs were added to the teams. An attempt to visit the magnetic pole, then only about two days' journey away, had to be abandoned as many of the dogs were in the first stage of the epidemic, so we made for the first native sealing camp visited on our former trip, where I had left dog food and trade goods which would be necessary before reaching our journey's end. I met two families of natives, who proved to be members of the small band based on Bellot Strait. They had wandered far from home, no doubt intending to connect with the spring caribou migration at the earliest possible date. Rae Strait is a fair sealing ground and is also the hunting ground of many polar bears, their tracks being seen at frequent intervals.

When on the evening of April 12 we reached our cache of dog food and trade goods, more dogs had died and a number of others were unfit for work, so we decided to push on for Pelly Bay, where in the event of further casualties fresh dogs could be secured from the Akovaligjuakmeuts. Four days were spent in reaching Kog ma telle along a direct course which led us through many miles of extremely rough ice. This advance cost us four more dogs and left the others less than half efficient. At Kog ma telle two native families, who had four good dogs between them, offered to accompany us as far as Pelly Bay. Soon after leaving this point we were forced by the weak-

ness of the dogs to divide our loads, one half being taken and cached some miles out on the trail, the rest being moved on the following day. In the afternoon three caribou were seen crossing the river ahead, all of which were later shot by one of the natives.

During the day we had passed along the southern boundary of an area that was undoubtedly an ancient sea-bed. The river-banks showed a cross-section of 50 feet in depth consisting of a light blue clay which had become hard and was filled with sea-shells. This formation continued about 7 miles along the river-bank and apparently extended some miles to the north. The rocks of the rest of the country along this section were archean, the hills being low and the watercourses wide and flat. As we proceeded inland vegetation became more plentiful, the river flats and lower plateaux being thickly covered with a coarse grass, and patches of moss and heather with occasional willows. We reached the lower end of Simpson Lake on the 24th, camping in two old igloos which had been built by Pelly Bay natives (Akovoligjuaks). An Akovoligjuakmeut trail was found leading towards Pelly Bay. This we later followed, as more dogs were necessary to take us to Repulse Bay, which was still 250 miles away.

On May 1, after a difficult journey in bad weather, we came upon a wide valley which we followed east for 7 miles, when salt water at Pelly Bay was reached. Simpson Peninsula was in sight from the high land before reaching camp, and many islands were seen in Pelly Bay, the most notable being Akovoligjuak, so named from its resemblance to a right whale. It is from this island, the outstanding landmark of the district, that the local natives take their name.

On May 4 an Akovoligjuak native and dog team came into camp and spent the night with us. He reported a sealing village 10 miles to the south-east, but told us that nearly all the Akovoligjuakmeuts had gone to Repulse Bay to trade. On the following day we reached the seal camp and built an igloo. Here we spent the next day overhauling and again reducing the outfit, as it was necessary to make the trip to Repulse Bay without relays as our fuel was almost exhausted and food none too plentiful, our last case of hard tack having been partially soaked in coal oil. Arrangements were made for ten dogs to accompany us to Repulse Bay, and seals and fish bought for dog food.

Travelling south we reached land on May 8, when we changed our course to easterly and after five hours' slow travel reached a fairly large stream, where fresh water was obtained by digging through 65 inches of ice. This not only gave us unlimited water but enabled us to save our oil, which was getting perilously low. Two days later the weather turned very warm, softening the snow, and by May 12, when camp was made on the summit of a ridge, the snow would no longer stand up for the roof of an igloo, so we built only a 4-foot wall and drew a sledge cover over the top for a roof.

The country from Kog ma telle on the Murchison River to this camp consists of rough igneous rock. A limestone area crosses the southern end of Pelly Bay and continues east and west, the eastern extension reaching Committee Bay. A considerable part of the area charted as water at the southern end of Pelly Bay is in reality a low-lying limestone country with the higher archean hills visible farther to the south. These have manifestly been mistaken

for the southern coast-line of the bay. Limestones reappeared about halfway across Simpson Peninsula, the country consisting of wide level stretches well covered with grass, with an occasional low gravel or limestone ridge striking north to south.

No caribou were seen on Simpson Peninsula, but occasionally the tracks of small bands were crossed. Fox signs were not so plentiful as on Boothia, but marmot abounded throughout the limestone areas. Several of the streams entering Pelly Bay are well stocked with fish, some of which, very like a lake trout in appearance, grow to a great size, 60 pounds being not uncommon. The native reports indicate that later in the season a great number of caribou pasture on the eastern side of Simpson Peninsula. They report, also, that for many years a number of musk ox have inhabited the land on the western side of Committee Bay.

On the morning of May 14 the weather had cleared and the temperature risen to above freezing, and ten strenuous hours in the soft snow brought us the shore-line of Committee Bay. The aneroid indicated a drop of 300 feet between this camp and the last, but as atmospheric conditions were changing constantly this reading may be far from correct. Throughout the day a series of plateaux were crossed, the elevations decreasing as the coast was approached.

We now followed the west coast of Committee Bay southwards, and after about 25 miles igneous rocks reappeared on the coast-line, which formation continued until Repulse Bay was reached. Towards evening the ice conditions changed from perfect to quite rough with deep fresh snow, the temperature being too high to allow the day's drift to pack. A camp was made in an abandoned native igloo which marked the trail of the Akovoligjuakmeuts en route for Repulse Bay. The condition of the party at this stage of the trip, while not critical, had reached a point where it might easily become so, owing particularly to the condition of our eyes and the serious fuel shortage.

Next morning the storm was blowing even more strongly than on the day before, but we felt that it was wisest to push ahead in spite of weather, as the post at Repulse Bay was not more than 100 miles away. We passed members of the Akovoligjuak settlement returning to their own country from Repulse Bay. These people purchase no food from the traders, depending entirely upon the country for their subsistence. Their spring diet consists almost entirely of marmot, of which they had secured an abundant supply on Rae Isthmus, with plenty more awaiting them on Simpson Peninsula. The average catch of white foxes in the Pelly Bay district for the preceding winter had been about ten for each hunter, three hundred in all being secured. It should not, however, be inferred that the country is therefore lacking in fur, the comparatively small catch indicating rather that by far the greater part of the season was spent in securing food and fuel, the taking of fur being only incidental to the ordinary routine.

We reached land at Rae Isthmus on May 17. For 5 miles we had travelled east, and then turned south across a wide grassy flat which constitutes the delta of a stream entering Committee Bay. At this point our trail climbed steeply several hundred feet to a grassy plateau which was dotted with ponds and small lakes. During the early part of the next day our trail dropped from the high plateau country to a chain of long narrow lakes, which we followed

throughout the rest of the day. On these lakes and their connecting streams water was beginning to show on top of the ice, a fact which enabled us to dispense almost entirely with the use of fuel. A short stop was made at each of two native camps which were encountered along our trail. The natives reported themselves as three days out from the trading post, but as they move very leisurely this did not necessarily mean that it was any great distance. It was their intention to remain there for several days, during which time they hoped to secure enough meat, chiefly marmot, to ration them across Committee Bay. After having travelled fifteen hours with the coast-line not yet in sight we built a rough snow and canvas shelter, where we spent the night.

The next day our trail lay along the chain of lakes which had been our guide on the previous day. This watercourse discharges into the extreme western end of Repulse Bay, a small rocky hill immediately adjoining its mouth on the north being the site of the winter quarters used by Dr. Rae of the Hudson's Bay Company more than seventy years ago. The stone foundations of his building are still intact. After reaching the salt-water ice the north coast-line of Repulse Bay was followed in an easterly direction for 12 miles, when the Hudson's Bay Company and Revillon Frères fur posts were reached, and we were once again in touch with civilization.

AN EXPEDITION IN ARNHEM LAND IN 1928

DONALD MACKAY

I SELECTED Arnhem Land as my objective for exploration in 1928 as one of the last portions of Australia that had not been examined. No definite boundaries are given to Arnhem Land, but probably they would be on the north and east the sea, on the south the Roper river, and on the west the South Alligator river. Quite a considerable area on the western and southern fringe of Arnhem Land is held under pastoral lease; but although men such as P. Cahill, Copley, Playford and J. Rogers found their way farther in, no report was ever made available of the country they traversed.

The natives of Arnhem Land have always had a bad reputation. Even the Dutch navigators who in 1623 named this part of Australia Jave la Grande said it was peopled by a cruel, poor, and brutal nation. Unfortunately, up to the present day many seem to have the same impression. During the expedition we came in contact with a considerable number of natives. They were very shy and difficult to approach. On one occasion we induced nine of them to join the expedition, but after three days they disappeared.

On 3 April 1928 the party left Sydney by S.S. *Marella* for Darwin, arriving there on the 13th. Here all available information from the Survey Department was obtained, and on the 15th we left by special cattle train for the Katherine, 200 miles south. This was reached after a thirteen-hours' trip. On the 16th a start was made for Roper Bar, some 240 miles south-east. The rugged tablelands east of the Katherine make it impracticable to enter the interior of

Arnhem Land in a direct line; hence the detour via Marramboy, Mataramka and Elsey river to Roper Bar.

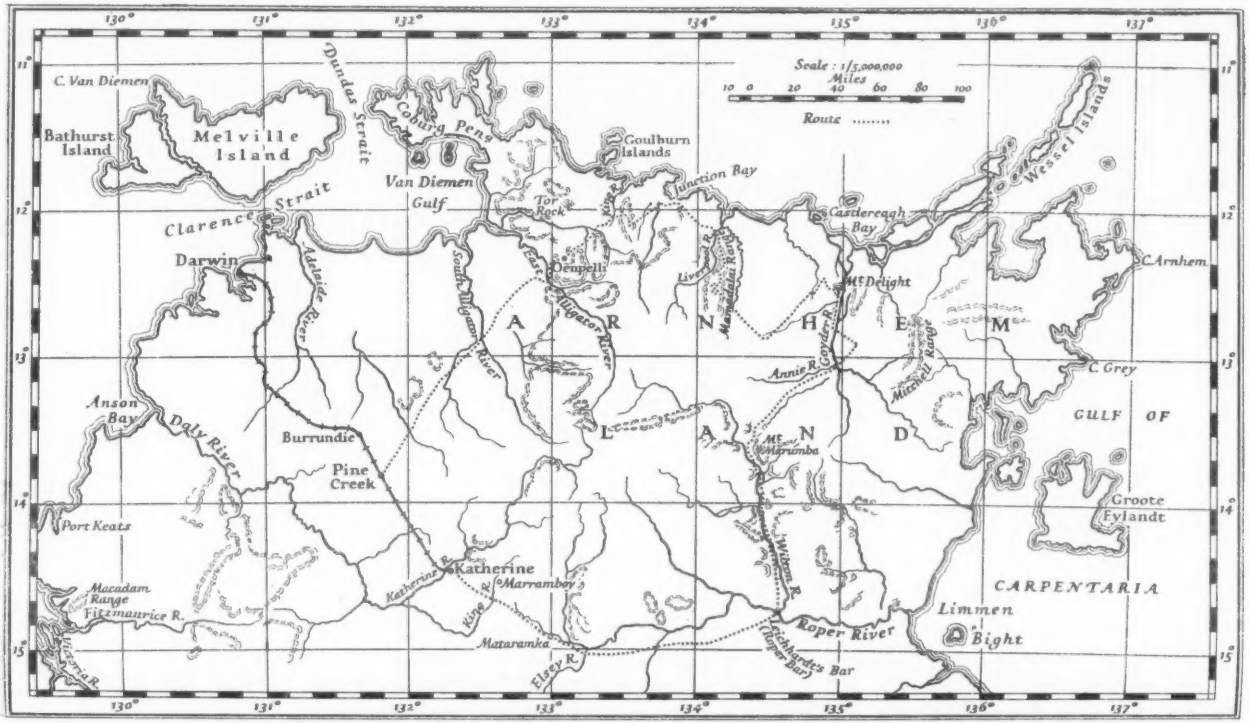
Fording the Roper at a rocky crossing known as Roper Bar, after a few miles we came to the Wilton, which we intended to follow north. Some obstacles had to be surmounted, the first being a chain of rough quartzite hills that end abruptly at the bank of the river, causing us to make a considerable detour. Farther north deep creeks that head from a range west of the river have cut channels in many places 16 feet deep. Grass over 6 feet high grows densely along these watercourses, and as their banks are in most places too precipitous for a heavily loaded horse to descend, some time was lost in finding suitable crossings. On this stage wild turkeys and quail were plentiful, and kangaroos, wallabies, and buffalo were seen.

After passing Mount Marumba we decided to leave the Wilton and strike a north-east course to reach the Goyder. The travelling was through low limestone hills, then through stringybark and woollybut forest, with occasional flooded areas densely timbered with paper-bark, which also grow in a regular thicket round swamps. Though we could see the water at times it was most difficult to water the horses. Now that the dry season was well advanced a large area on the fringe of these swamps, though dry on the surface, would hardly support the weight of a man. On this north-easterly course we came on an unnamed river, and later struck the Goyder at its junction with the Annie.

We now crossed the Goyder, finding a ford without much difficulty. During the wet season this river would be 60 feet deep and of considerable width. For a mile after crossing we travelled through high spear grass; then the country changed and we had to force our way through dense ti-tree scrub, eventually coming to some low hills which we ascended, getting a good view between this point and the Mitchell Range, but seeing no alteration in the country. We then changed our course to west 15° north, and again struck the Goyder, followed it north, and had much difficulty in crossing some of the tributaries. One of these streams we found was the outlet of a big swamp, so we had to make a crossing near where it joined the main river. Fortunately the water was not deep, but its banks were a veritable quagmire, which meant making a corduroy bridge, a job at which we became experts before the trip ended. Along the banks of the Goyder, *Zania* and *Livistonia* palms grow in profusion, a relief after our weary journey through the forest and scrub country.

Reaching Mount Delight we changed course to west, but after some distance struck rough quartzite hills; between those the valleys are well grassed, but in places there are considerable areas of swamp. The roughness of this country forced us to change our course to south-west, but after some 40 miles we again changed our course to north-west. Tracks of natives were seen, but we were able to get in touch with only one small party.

In another 50 miles we struck exceedingly rough sandstone tablelands, and lost considerable time in finding a pass to reach the level country on this western side. These tablelands rise to a height of 1000 to 1200 feet, broken by gorges and ravines. Time and again we followed ravines walled on either side by ragged cliffs, only to find our path barred by an inaccessible barrier. On



The route of the Mackay Expedition in Arnhem Land, 1928, from the map by Dr. Herbert Basedow

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these tablelands we passed many native shelters, some 30 feet long, made by laying sheets of stringybark over a rough sapling frame. In them we found many spears stored, but apparently they had not been used for some time. During the dry season the natives live and hunt on the low-lying country and find the use of shelters unnecessary.

Eventually we succeeded in finding a pass and descended to the lower country. Here the country was undulating and well grassed. Defined native pads could be seen, and on the Liverpool river was a fair-sized camp of natives, who immediately took to the bush on the other side of the river. Fortunately, after waiting for some hours we were able to get in touch with them, and eventually induced nine to accompany the expedition.

At this point the country becomes so rugged that we were forced to change our course to north and hold it until we came within 5 miles of Junction Bay. After three days' travelling our native escort disappeared. Several rivers had now to be crossed. At one a horse got so badly bogged that he had to be shot, and on another occasion, but for the assistance of some of the local natives, a patch of quicksand would have caused a further loss to our team.

We now shaped our course south 20° west, but after travelling two days on this bearing came to precipitous cliffs which at this point are impossible to descend. Turning due north we followed this high tableland. Seeing many smoke signals on the big expanse of undulating country to the west, we replied by firing large areas of spinifex, but failed to get in touch with the natives. After travelling some 12 miles we found a pass that enabled us to descend to the lower country.

From here to Oenpelli Mission Station the country is intersected by many bold sandstone bluffs that made deviation from our course frequent. Oenpelli is perhaps the most fertile spot in North Australia, surrounded by beautiful scenery. Thence our course was south-west to Pine Creek 180 miles, and from there the horses were sent back to the Katherine, five of their number having been lost during the expedition. From Pine Creek we took train to Darwin, and left there by steamer on 8 July 1928.

From a pastoralist's standpoint the country traversed by the expedition is disappointing. Most of it might be called second-class cattle country. On the tablelands and slopes the country is thickly timbered with stringybark and woollybut and patches of Cyprus Pine. These areas are very lightly grassed. On a considerable amount of the undulating country and tablelands loose stones are distributed over the surface. Many of the valleys contain rich alluvial deposit, and are heavily coated with spear grass, but their area is too small to make the carrying capacity of the country as a whole commercially attractive. From Mount Delight to Mamadalai Range there are some fertile valleys broken up by rough quartzite belts and swamp areas. Across the Mamadalai Ranges the country is exceedingly rough, with much spinifex. From here to Oenpelli one finds occasional rich pockets of country hemmed in between rugged sandstone hills. Except east of the Goyder, and in the sandstone ranges, water is plentiful and of excellent quality. Though most of the country is heavily timbered, the trees are only of medium size and many are pipey and are not an asset for milling. Some of the Cyprus Pines are fine specimens, but these only grow in isolated patches.

The route of the Mackay Expedition in Arnhem Land, 1928, from the map by Dr. Herbert Basedow

NOTES ON THE ABORIGINES AND ON THE GEOLOGY OF ARNHEM LAND

HERBERT BASEDOW, M.P.

ARNHEM Land is inhabited by several tribes or tribal divisions which are grouped linguistically. There are four main divisions: Tauwan in the south-west (also known as the Maiali); Nara in the south-east; Rembaranga in the centre; and Kakatu in the north-west. Although much alike in their general customs and appearance, the Kakatu group differs from all others in that they do not practise the rite of circumcision. At the time of our visit, most of the natives were living in the tablelands, but during the wet season (November to March) they spend a good deal of their time in hunting in the sandhills. It is during this period also that they construct long bark huts and shelters to live in.

The natives of Arnhem Land are artistically inclined. Many caves were visited in which numerous ochre drawings covered the walls as well as the roof. In many places the artists of the tribe had been at work in all probability for centuries past, as was evident from the fact that the same surface had been decorated time after time.

The natives of Arnhem Land have a reputation for being treacherous and bloodthirsty. Those with whom the expedition came into contact were usually quite friendly and nervous. In addition to those actually seen en route, there were others whose presence could be detected by the smoke signals which surrounded us at times. For some unknown reason, these natives held aloof and remained under cover. It was with great difficulty that some of them could be induced to come near and accept presents. Whenever two or three did consent to meet us, they seemed very suspicious of the party, and it was apparent that they had at some time or other been badly treated by strangers of a lighter-coloured skin than themselves.

The tableland which occupies the greater part of Arnhem Land is composed of beds of fine and coarse-grained sandstone, grit, and quartzite. Here and there the beds are distinctly gravelly, as for instance west of the King river, while south of Junction Bay some very extensive exposures of ancient conglomerates were observed. On the Wilton river, moreover, arenaceous shales underlie the quartzites.

The tablelands are bounded on the west by Pre-Cambrian schists, gneisses, and clay-slates, and Cambrian limestones in the Katherine–Burrundie district. These ancient beds are also exposed in the Wilton valley, at Mount Marumba, at Oenpelli, and elsewhere. The schists are known to contain lode-formations carrying gold and silver-lead ores. There are intrusive dykes of dolerite, diorite, greisen, and granite. The limestones belong to the *Salterella hardmani* series which is typically developed at the Daly river, in the Barkly Tablelands and east of the Queensland boundary.

The sandstones and quartzites are on the whole not far from horizontally bedded. They contain numerous veins of barren, glassy and milky quartz. The grains of the sandstone are fairly well rounded; the cementing material is siliceous and occasionally argillaceous, with fine flakes of sericite mica. The pebbles and boulders included in the conglomerates are mostly quartz, more or less micaceous.

An interesting feature is that in the Wilton Valley certain zones of the quartzite are chalcedonized and show a conspicuous oolitic structure which is very characteristic when viewed under the microscope and in thin sections. A careful search for fossils in these beds proved negative; it is difficult therefore to state the age of the formation. It has been suggested by G. J. Gray that these beds might be Permo-Carboniferous and correlated with the sandstones of Port Keats, Anson Bay, etc. With this suggestion I cannot agree, and would point out that there is not the slightest similarity, lithologically or otherwise, between the two series. The sections mentioned by Gray were worked by H. Y. L. Brown and myself in 1905 as members of the Government Geological Exploration of the Northern Territory. I have revisited part on several occasions since. In a report published by H. Y. L. Brown in 1907 it is further suggested that the coastal sections of Arnhem Land are probably Permo-Carboniferous, and that the outliers of the great plateau, such as Tor Rock, are Older Primary. In 1911 W. G. Woolnough accepted Brown's classification of the coastal sections as Permo-Carboniferous.

Great diversity of opinion has been expressed in regard to the age of precisely similar beds (continuous with the coastal exposures) which occur in the Katherine and Roper river districts. Whereas Brown classes them as Cretaceous in the former and Ordovician in the latter, Woolnough includes them under the headings of "Plateau Sandstones, Age Uncertain" and "Cambrian" respectively. As previously pointed out by me, the formations are all of the same age, which I originally described as Ordovician (Victoria, Fitzmaurice River, Macadam Range, etc.). After having had an opportunity of studying the extensive plateau of similar quartzites in the Northern Kinberleys of Western Australia and the fossiliferous beds of Central Australia, I prefer to class these beds as Cambro-Ordovician. The Arnhem Land formation is in every respect similar to the others mentioned.

The sandstone and quartzite beds rest upon the eroded surfaces of the crystalline schists, granite and other intrusive rocks occurring in the region. The bedding planes dip on an average about 5 degrees south on the East Alligator river, but there is much drift-bedding and change in the strike, the angle of dip being in places as much as from 25 to 30 degrees. There is abundant evidence of folding, faulting and jointing. A regular system of joints is responsible for the characteristic form of weathering displayed by the rocks. The old land surface can be discerned in many places, consisting of quartzose and micaceous schists with abundant secondary minerals such as chlorite. Laterites are developed over practically the whole extent of Arnhem Land; they are of comparatively recent age.

There is little or no chance of finding any mineral of economic value in the quartzites and sandstones composing the great plateau of Arnhem Land. The underlying fundamental complex of rocks is more hopeful, but their exposures are limited. The most promising field for prospecting which was observed is immediately west of the King River. At this place low schistose hills were noted, capped with haematite and quartz débris. The country has all the appearance of being gold-bearing. Owing to the rough and inaccessible nature of the ground, however, any discovery which is made will have to be of more than average value if it is to become of economic importance.

RIVER CHANGES IN THE EASTERN TARIM BASIN

LIEUT.-COLONEL R. C. F. SCHOMBERG

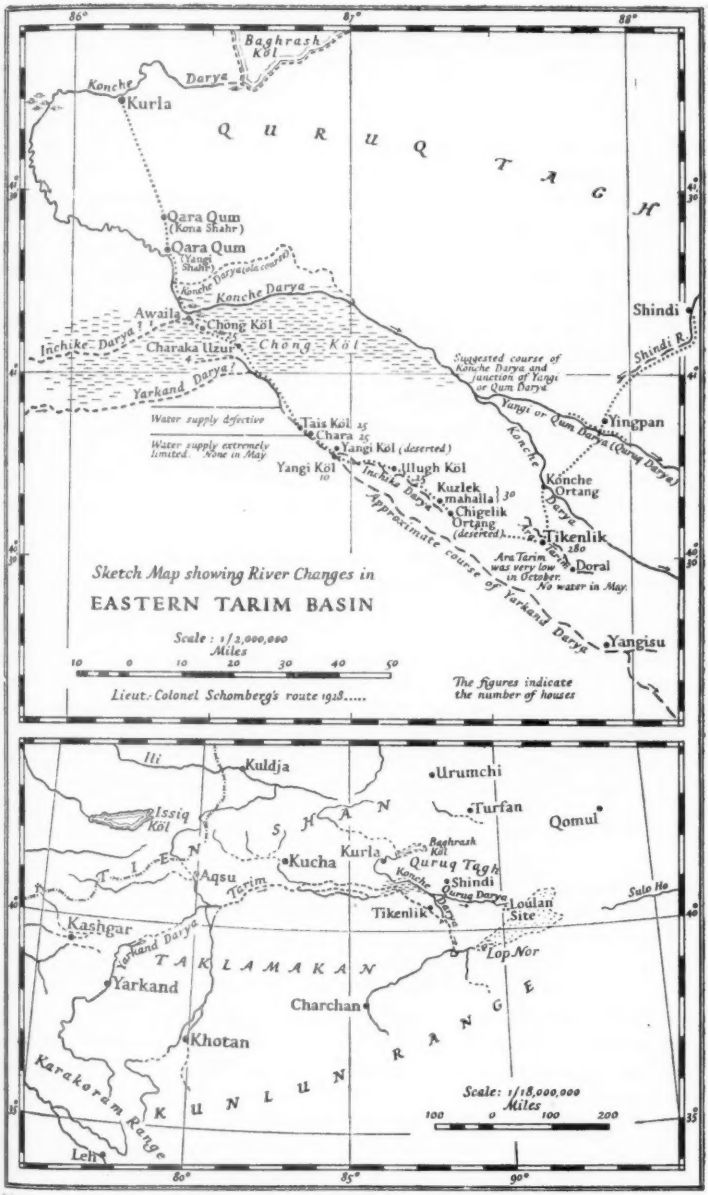
A JOURNEY from Urumchi through the Quruq Tagh in October 1928 brought me to Shindi, where Abdur Rahim lives. This is the man who accompanied Sir Aurel Stein on his journeys in the deserts of the Eastern Tarim basin and beyond, and who possesses glowing testimonials from that distinguished traveller. In Urumchi I had heard from members of a Sino-Swedish Expedition that there had been changes in the rivers of the Tarim basin, and Abdur Rahim was able to confirm and elaborate this report.

Leaving Shindi, the track led along the Shindi river valley out on to the barren sai south of the Quruq Tagh. Passing Yingpan, 4 miles on, we met the river known to the natives as the Yangi (new) or Qum (sand) River, and which was in fact the Quruq Darya of Sir Aurel Stein's explorations in this area, come to life again. The level of the river had been higher, but as it was now the end of October, the volume of water was less. Even so, the river was a fine stream with an average width of 200 yards. Judging from the banks and the scarcely dry sand spits, the stream must have been at least 400 yards wide a few weeks previously, and it was still a formidable obstacle. It was remarkable to see this great river rolling through an arid region. The dead tamarisk cones and the gaunt, stark toghraqs contrasted strangely with the volume of water beneath them. It was noticeable, however, that fresh reeds were springing up, and that the river had already an effect on the desert vegetation near its banks. The work of erosion was evidently going on. All the time the heavy thud of falling sand could be heard.

My original intention had been to follow the river to its end, but it was too early in the season to do so. The water, the swamp, and the conditions generally, made it impossible and the journey was put off till the swamps were frozen and the water less.

Travelling via Tikenlik, Chong Köl and Qara Qum to Kurla, it was possible to gather what had happened. The new river was five years old—possibly six years. Therefore 1923, or more probably 1924, is the year when the Quruq Darya came to life again. The people of the district said that they had noticed a decline in their water supply fifteen years ago. They were accustomed to get water in May and October. Five years ago the May supply failed. The October supply continued, though much less than before, but in October water is of little use.

The new river was fed by the Chong Köl and the Konche Darya. The result of this was that all villages south of the village of Chong Köl suffered considerably. Tikenlik had lost 220 out of its 500 families. Doral and Yangisu were in a worse case. Yangi Köl was in a hard way, and one mahalla was deserted. Before long all this area will be abandoned. By using wells the people have managed to carry on, but this supply will shortly dry up. The Konche Darya between the Yangi or Qum Darya and Tikenlik was a small but deep stream, though it was easy to see that it was nothing like its normal size. The same river south of Qara Qum flowed in a different channel from that shown in the map. It was three times its original width, and, where the ferry was, probably measured 300 yards across, if not more.



River changes in the Eastern Tarim Basin.

A number of villagers insisted that this calamity of a change of course and the birth of a new river was due to canals being cut to irrigate the grazing-grounds north of the Chong Köl, and the villagers wished to revenge themselves on the big "bais" who had done so. This explanation, however, can carry no weight. The situation seems to be that there has been an accumulation of water in the area south-west of Kurla which is now (November 1928) quite impassable except by boat. The channel of the Yarkand River has, in course of time, become choked. There is thus a barrier of sand which has diverted the drainage of the Chong Köl farther east. This immense flow of water, meeting the Konche Darya, has taken along with it most of the water of that river. The result of this is that the Konche Darya below its junction with the Chong Köl water only receives some surplus water, just as the Yarkand Darya does. The surplus water occurs in October and is due to the irrigation water being turned off the land at the end of the season in the areas north and west of Chong Köl. What is remarkable, however, is that the Chong Köl water should have gone beyond the Konche Darya. It would seem more natural to combine with the latter river, and make a larger channel of the already existing one. The end of the Yangi or Qum Darya is said to be a large swamp west and north-west of the Loulan area, so that the ancient site is now only accessible from the east and south, *i.e.* from the Lop Nor direction.

This account may seem fantastic to those accustomed to rivers flowing in regular beds, with perhaps a rare and local divergence of a few yards. As a matter of fact, there is nothing unnatural about what has occurred. The rivers that drain into the area between the Tien Shan and the Kunlun pour themselves into a vast plain of sand, broken only by dunes or ridges themselves the result of fluvial action, or by equally unstable undulations produced by the wind. There is really nothing to control the course of a river once it has entered on this welter of sand. The channel that it carves for itself cannot, from its nature, have any permanence. Indeed, it is rather a source of wonder that there are not more changes in the beds of the rivers which discharge their vast volume of water into the fickle sands of the Taklamakan desert.

THE DUKE OF SPOLETO'S EXPEDITION TO THE KARAKORAM

Communicated by Major Kenneth Mason, Survey of India

NEWS has been received from Kashmir of the return of the Duke of Spoleto's Italian expedition from the Karakoram. The party was organized as follows: H.R.H. the Duke of Spoleto (leader), Commander Mario Cugia (second in command), Signor U. Balestreri (in charge of climbing and caravan), Colonel Gino Allegri (doctor), G. Chiardola (topographer), Professors V. Ponti, A. Desio, L. Di Caporiacco. There were also a cinematographer, a wireless operator, and two experienced Courmayeur guides, Evaristo Croux and Leone Bron. The expedition arrived in India in February and March, and left Srinagar in three parties on March 27 and 30 and April 3.

By the middle of May this strong party was concentrated at Ordokas, at an altitude of 13,900 feet, 17 miles up the Baltoro glacier from its snout. The Duke of Spoleto here established his base camp on the site of the depot formed in 1909 by his uncle, the Duke of the Abruzzi. After a brief period of bad weather a preliminary reconnaissance was made to the summit of the Muztagh pass, crossed with so much difficulty from the north by Sir Francis Younghusband in September 1887 on his famous journey from Peking to India. This reconnaissance proved the Muztagh pass to be practicable, and a party of three climbers and a geologist was formed for the survey of the Middle Shaksgam. Success attended this journey. The Muztagh pass, 19,030 feet, was crossed and the Sarpo Laggo glacier and valley descended to the junction with the Shaksgam river. From here the main valley of the Shaksgam was followed up, past the snouts of the Gasherbrum and Urdok glaciers, discovered in 1889 by Sir Francis Younghusband. The valley beyond the Urdok glacier was now traversed for some 20 miles, to the west bank of the Kyagar glacier, discovered and surveyed by Major Kenneth Mason, of the Survey of India, in 1926. His cairns, placed for the stereographic survey of the Shaksgam on the high ridge east of the Kyagar glacier, were identified. Owing to shortage of supplies no attempt was made to force a crossing of this glacier, which completely blocked the main valley, as in 1926; and the party returned down the Shaksgam.

Meanwhile another party ascended the main Baltoro glacier to Concordia, the junction of the Godwin Austen glacier descending from K_2, with the main trunk from between Gasherbrum and the Golden Throne of Sir Martin Conway's 1892 expedition. The Duke with two climbers reached a height of about 22,000 feet, from which point they could recognize Conway's "probable saddle," showing that there is a possible way over the watershed here to the Urdok glacier and Shaksgam valley.

At the end of July the expedition left the Baltoro glacier. A geological party explored the Trahonge glacier with the object of trying to make another pass to the Sarpo Laggo glacier, but this object was not attained. They also explored and made a topographical sketch of the Punmah glacier, which was first explored by Godwin Austen in 1861.

Besides the main objectives of the expedition, namely the crossing of the Muztagh pass, the exploration of the Middle Shaksgam, and the examination of the head of the Baltoro glacier, much valuable scientific work has been accomplished. A complete stereographic survey has been made of the Baltoro glacier, and topographical sketches have been made of the middle Shaksgam valley and of the Punmah glacier. Magnetic observations were made at Ordokas, Concordia, Paiju, Askole and Dassu. Gravity pendulums were swung at Ordokas and Askole. The naturalist made valuable collections of insects in the Biaho valley, on the Baltoro glacier, and in the Sarpo Laggo, while the surgeon, whose specific duties seem to have been light owing to the general good health of the party, carried out important anthropological work in Baltistan.

The expedition returned to Srinagar by the Deosai route, and was to sail from Bombay early in October.

THE ORIGIN OF THE FAIYUM DEPRESSION: THE FAIYUM AND UGANDA

K. S. SANDFORD AND W. J. ARKELL

IN a paper entitled "The Origin of the Faiyum Depression," published in the October number of this *Journal*, Miss E. W. Gardner has put forward what purports to be a "Critical Commentary" of a theory held by us. We wish to point out that this commentary is based on nothing more than two abstracts, in all some two columns in *Nature* and three pages in *Man*, in which we stated that the results of our season's work on the Faiyum problem would shortly be published in full by the Oriental Institute. The technical work of producing this publication is being carried out with all possible expedition by the Institute, and we hope that it will be ready, together with a detailed geological map of the area, before Christmas.

As the matters dealt with by Miss Gardner are treated fully, in their proper place and sequence, in this embodiment of our geological work on the Eastern Faiyum, we need not republish the evidence here. We would point out, however, that a short abstract, in anticipation of a full report, is not so written as to set forth adequate evidence for a detailed criticism. We venture therefore to attribute to the premature appearance of Miss Gardner's Commentary, rather than to our own oversight, the inadequacy of evidence of which she complains.

Miss Gardner has applied synthetic methods to our abstracts, and has attempted to elaborate our theory from the bare outline of facts provided by us. Unfortunately, the resulting product differs vitally from the original. We must emphasize that the diagram published by Miss Gardner in the *Journal* opposite p. 416, and headed "Depth of erosion, and climate according to K. S. Sandford and W. J. Arkell," does *not* represent our views. The same must be said of the table under our names on p. 372. In this diagram and table we are depicted as believing that the level of erosion fell steadily until near the beginning of Neolithic times, and that a lake came into being in the Faiyum at the 35-metre level and continued to fall with the falling surface of erosion as far as the 22-metre level. On this hypothesis the principal erosion of the Faiyum basin would have been taking place at the same time as the basin was occupied by a lake, and the depth of the lake, which may be read off from Miss Gardner's diagram, was always zero. It must have surprised her that we found a lake of no depth compatible with the formation of the high storm beaches of shingle which we described.

The explanation is, of course, that we are fully aware of the erosion suffered by the Tertiary floor underlying the lake-beds within the Faiyum, discussed by Miss Gardner on pp. 376–7. This surface of erosion descends to an unknown depth below the Mousterian lake-level, and the lake-beds lie upon it. Since there can have been no lake without previous erosion of a basin, perhaps we may be forgiven for having taken for granted that the erosion antedated the formation of the Mousterian lake, and for thinking it unnecessary to labour the point. We said in *Nature* (*loc. cit.*, p. 671, col. 2): "But, owing to the extremely soft strata locally exposed, a broad plain had been formed at a low level, and the drainage of this could only escape into the Nile by cutting a passage (the Hawara

Channel) between two of the Pliocene valleys choked with virtually indestructible materials. In Middle Palaeolithic times this plain first appears definitely as a lake, and for the first time we find a reversal of drainage." And again in *Man* (*loc. cit.*, p. 3): "It is thus shown that the Faiyum depression was by Mousterian times occupied by a vast lake, the connection of which with the Nile is now no longer a matter of conjecture or assumption."

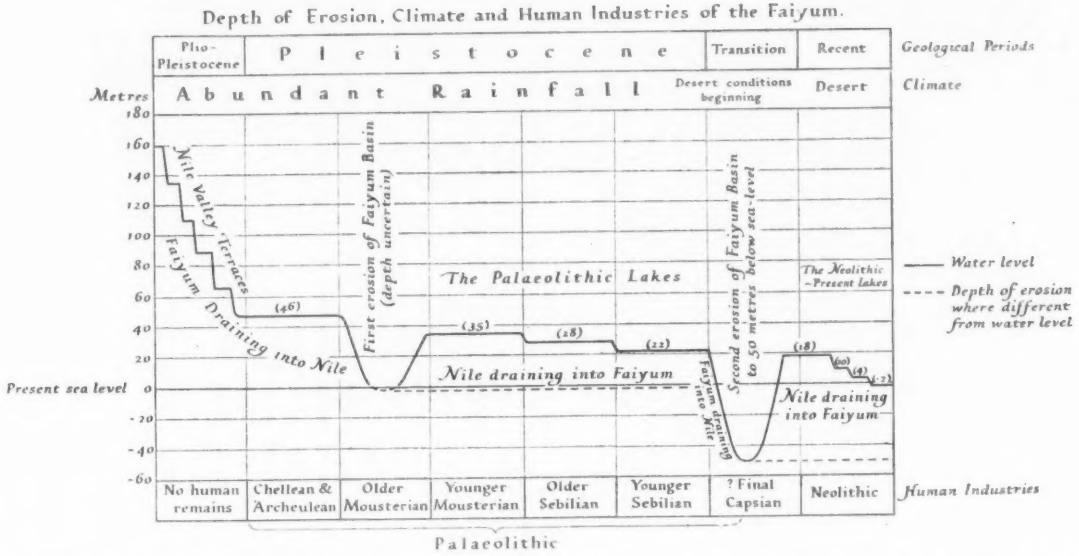
This first episode of erosion does not appear in our list of terrace-levels, because if it left any terrace feature behind, it is buried below the alluvium. Our reasons for thinking that a terrace stage corresponding to this episode is represented, though buried, in the Nile Valley, *i.e.* that Nile and Faiyum erosion levels fell together and therefore were probably connected, are based on a notable gap in the typological sequence of implements in the Lower Nile terraces, a subject discussed in our forthcoming work.

The depth to which this first erosion was carried is, so far as we are aware, still unknown, although in Miss Gardner's own diagram (*loc. cit.*, facing p. 416) it is represented as descending to 50 metres below sea-level, or as far as the deepest part of the Faiyum basin. Miss Gardner has not published any evidence in support of this hypothesis, and the only evidence which we could accept would be a lake deposit at that depth containing an indisputable "site" of Mousterian implements similar to or older than those which we have found in the beach at 112 feet above sea-level. In a letter to *Man* (July 1929, p. 132) Miss Caton-Thompson speaks with confidence of the "association" of Mousterian implements with the lake deposits below sea-level, but we are left in doubt what that association is.

Needless to say, we found Mousterian implements on, and mixed with, the shingle of lower (younger) lake beaches. They were usually waterworn, although in lake deposits, especially those of finer sediment, there is no reason why derived implements should not occur in virtually fresh condition. The discovery of Mousterian implements at any level below the 112-feet beach in association with younger beaches, as recorded by Miss Caton-Thompson, seems to us an essentially normal state of affairs.

Our choice of sea-level as the probable extent of this first erosion was purely arbitrary, some convenient datum being required by which to express our belief that the second erosion was deeper than the first. We submit that for all the evidence yet published, our statement in *Nature* (*loc. cit.*, p. 670, col. 2) that "The excavation of *that part of the Faiyum basin below sea-level* must, in view of the above, be relegated to late—or post—Sebilian times, when the Nile cut a deep channel" remains unrefuted.

We would point out that the greater the depth to which this first erosion is supposed to have been carried, the less likely does it become that the erosion was effected by desert wind action as postulated by Miss Gardner, and the more convulsive becomes the cataclysm involved at the supposed "breaking in of the Nile" as shown in Miss Gardner's diagram. According to this diagram the vertical height of the divide which stemmed back the Nile, measured above the bottom of the supposedly dry Faiyum depression, is at least 80 metres. We think that those who read our evidence, however, will agree that no such divide existed and that the Nile never "broke in," but that the water in the Nile and its tributary wadi, the Faiyum, sank and rose as a single unit.



1. *This diagram is drawn to replace that published by Miss Gardner, 'Geogr. Jour.,' 74, October 1929, Fig. 3, opposite p. 416, which does not correctly represent our views.*

2. *No attempt is made to portray the relative lengths of the periods. If that were done, the left-hand column would probably have to be drawn at least as wide as the rest of the diagram.*

3. *The levels of the Palaeolithic lakes are as determined by us, those of the Neolithic lakes are after Miss Caton-Thompson and Miss Gardner.*

4. *The 18-metre (57-ft.) lake has in those authors' previous works been known as the Neolithic lake, but in Miss Gardner's latest diagram is represented as of Final Capsian age. We would prefer to consider it as more Neolithic than Capsian, the final Capsian industry (= Uppermost Sebilian ?) being probably contemporary with the Second Erosion Period, between the 74-ft. and 57-ft. lakes.*

With regard to this first episode of erosion, then, we are not nearly so much at variance with Miss Gardner as the two diagrams published by her might lead the reader to suppose. We differ from her only in thinking (1) that the erosion was not carried so deep (probably not below sea-level); (2) that it was accomplished by rain, not wind; (3) that, while it was proceeding, the debris or products of erosion were not blown away but carried into the Nile, which was then flowing at a correspondingly low level; (4) that when the Nile returned to fill the depression it did not break in, but merely flowed normally through the Hawara Channel in the reverse direction to the old tributary stream, gradually ponding up to form a lake. The maximum level reached by this lake was 112 feet above present sea-level, at which height there was a long pause, dated by implements we have found embedded in the beach shingle. The water-level then again sank, and the old lake-beds began to be exposed to the air and denuded.

On the matter of this second period of erosion we have but little to criticize in Miss Gardner's original descriptions published in the *Geological Magazine*. Miss Gardner believes that the Tertiary floor was not now lowered any farther than the level reached before the incidence of the Mousterian lake. We believe that the last 50 metres of its depth was probably added at this period; and Miss Gardner has not yet published any evidence which curtails our right to this belief. Miss Gardner cannot accept any explanation for the removal of the material other than that it was blown out under desert conditions, while all connection with the Nile was once more cut off. We regard it as more probable that the material was washed out by rainfall (not necessarily continuous or periodic) through the Hawara Channel into the Nile, which was once more flowing below its present level. It is our opinion, in fact, that the first cycle of erosion, reversal, and reponding to form a lake, was now repeated, but at an even lower level than in the first instance and below present sea-level.

On the Nile aggrading its bed once more (a movement still in progress) its waters flowed for a second time into the Faiyum. The new lake rose to 57 feet above sea-level before desiccation got the better of inflow under the influence of the newly initiated desert régime. This 57-feet maximum is the lake the shores of which were made known to us by Miss Caton-Thompson and Miss Gardner as the dwelling-place of the Neolithic people, and here our geological researches ended

A few points remain in Miss Gardner's commentary, which cannot be passed over uncorrected. On p. 379 we are alleged to have postulated in the Faiyum "a mighty stream," and on p. 381 "continuous and extensive river action from Pliocene times onwards," and again, "heavy continuous rainfall." These words are not ours and they do not express our views. We know of no region at the present day subjected to such rainfall, and where we are dealing with terraces we see no reason for supposing such conditions to have obtained in the past. The degree of intermittency of the rainfall of any geological period can only be determined in rare circumstances, and in this instance we can only say "there was heavy rainfall."

On p. 378, our theory is said to involve "an active and powerful river, flowing from end to end of the Faiyum," and nearly two pages are devoted to a fruitless quest for the headwaters of this imaginary river. We would point out that many hundreds of tributary wadis, many smaller than the Faiyum, many larger, open

into the Nile throughout its course through the northern desert belt. Such of these wadis as lie in hard limestone country are steep-sided, narrow, and often long; such as are cut in a softer terrain take the form of broad plains with hundreds of minor stream courses running into them from all directions. As instances we would cite the wide tract of low country on the Esna Shales behind Gebel Rahamiya in Upper Egypt, or again the Esna Shale country south of the Eocene escarpment on the west side of the river, south-west of Edfu, or the vast gravel stretches west of the Delta. There can be no doubt that these tracts were lowered principally by normal rainfall denudation, yet we cannot map out the details of the river systems upon their surface. Similarly we believe any such attempt as is made by Miss Gardner in the Faiyum (p. 379) to be futile.

We would point out that while Miss Gardner dwells at some length on the northern rim of the depression in her self-imposed task of finding the headwaters of a river, she dismisses the extensive and low-lying western end in a single sentence. Here, beneath the Oligocene scarp, the ground is soft and we should expect to find few terrace features preserved. One striking relic of a stream not mentioned by Miss Gardner came under our observation, nevertheless, on the north side of the Faiyum. Between Ilwet Hialla and the basalt-flows to the north-west runs a faulted valley, followed by the road from Cairo to the Birket Qarun. At the end of this valley, on the very rim of the Faiyum basin, we found thick, roughly graded mantles of wadi gravels, composed of resorted Oligocene pebbles. They yielded no implements, and their height was, in the circumstances of their occurrence, valueless, but they were an unmistakable relic of a stream of considerable volume having flowed at some period of the Pleistocene down the valley and out across the Faiyum, all lower traces being lost.

In conclusion, we must deprecate the publication of a geological map twenty-five years out of date. The geological information on this map has not even been brought up to date with that inserted in King Fuad's atlas, published in 1928, which itself is subject to considerable amendment where the Faiyum is concerned. We must warn readers who may use this map accompanying Miss Gardner's paper that the geology is not only inexact and out of date so far as it goes, but it suffers from so many and such great omissions that a wholly erroneous idea of the region is conveyed. The reason for this is that only the northern half of the area has ever been mapped geologically before 1928, and on that half the information concerning the late Tertiary and Quaternary deposits represents the best that could be gleaned in a pioneer official survey made at great pains, without modern facilities, with the primary object of determining the "solid" geology of the lower Tertiaries.

The above is of more than local interest since Miss Gardner claims support from work still in progress on the lakes of East Africa and Uganda. Mr. E. J. Wayland, however, in a communication* valuable out of all proportion to its length, warns us that, at the present juncture, no more than local significance should be assigned to the work now in progress in the East African lakes,† at least in so far as Pluvials and Inter-Pluvials are concerned. Moreover he places under much the same embargo the results of ten years' work which he and his Survey have achieved over the vastly greater field of geology in Uganda.

*_Man_, vol. 29, July 1929, pp. 118–121. †_Nature_, 6 July 1929, p. 9.

As he says, the Glacial-Pluvial correlation between European (Alpine) glaciations and East African and Uganda pluvials is seductive. He then so nearly succumbs to its charms that he dallies with the coincidence of pauses in fall of lake-levels in Lake Victoria (280 feet with pause at 225 feet (Mousterian)), and in the Faiyum (278 feet with pause at 222 feet*)!

Now 222 feet means that height above the datum employed by Miss Gardner, which was the height of the surviving lake in the Faiyum on 16 December 1925; the lake is controlled by irrigation engineers and alters accordingly. As a figure it means absolutely nothing but a height above a convenient datum: it means also 75 feet above sea-level at Alexandria. According to Miss Gardner and Miss Caton-Thompson, this height marks the Mousterian lake, but we have found late Palaeolithic implements in the beaches, and we have further proved that the Mousterian lake stood at 112 feet above sea-level (=259 feet above Miss Gardner's datum).

In any event the heights are referable (as we have shown) directly to Nile terraces, with which the beaches are in immediate contact. The Mousterian beach at 112 feet (259) is an offshoot of the 25-feet Mousterian terrace of the Nile, and the 75 feet (222) of the Late Palaeolithic Nile stage. The Uganda–Faiyum correlation is not a startling success, and Mr. Wayland is unquestionably correct in appealing for extreme caution in the matter of African Pluvials.

For ourselves we do not feel tempted, at the moment, to seek correlation with the far south. In a year or two we may have finished the survey of Nile deposits from the sea to the 2nd Cataract, but another 2000 miles of Nile lie beyond, which neither Mr. Wayland nor ourselves are likely to survey. When we have finished the first 800 miles of Nile from the sea we might think tentatively in terms of North African–Mediterranean–Alpine oscillations of climate; but at the moment the only correlation we would care to consider is that of the Mousterian Riss-Würm and Würm association, and we know that in Egypt the Mousterian spans an enormous period and a considerable vertical range of Nile deposits. Although the Lower and Middle Palaeolithic are at least homotaxially similar to those of Europe, we view these attempts at applying European chronology to North-East Africa with much misgiving.

While correlation by Pluvials and Glacials, aided by Palaeolithic implements, is not at the moment satisfactory, the Nile terraces promise to conform to a remarkable degree to the raised beaches of the Mediterranean, from which Depéret built up his well-known chronology of the Pleistocene period. Here tangible results may be expected. But to attach Depéret's chronology to the Alpine time-scale of Penck and Brückner, which has gained such overwhelming domination, is a very different matter.

We have received from Miss Gardner the following notes on the above paper:

By the courtesy of the Editor I am allowed to make a few comments on points of fact in the above paper.

1. Published views gain currency. Discussion of them after eighteen months can hardly be regarded as premature.

2. Drs. Sandford and Arkell did not only not "labour" the first low-level

*For this he accepts the Mousterian age given by Miss Gardner.

period of fluviatile erosion: they did not even mention it for the Nile Valley, which controlled the Faiyum levels of the time.

3. My map was not a geological map, but a topographical sketch to which, to facilitate reference, some relevant geological data were transferred from the official geological map.

4. It is incorrect to say that only the northern half of the basin had, prior to 1928, been geologically mapped. The whole depression (with the exception of a small area east of Gharaq)) was surveyed between 1898–1904. All published results of field work carried on in the depression since 1904 are contained in papers by Miss Caton-Thompson and myself issued between 1926–1929, and in the two abstracts under discussion by Drs. Sandford and Arkell.

5. The map of the Faiyum depression in the new 'Atlas of Egypt' is on a scale of 1 : 1,000,000. Apart from a redetermination of the age of the Fluvio-Marine Series as mapped by Beadnell, and the insertion of some Pliocene gravels in the south-east, mentioned in Beadnell's text but not inserted on his map, it is for all purposes connected with this argument the same as Beadnell's map.

6. Drs. Sandford and Arkell are not the first to see that the 35-m. (112-foot) lake is Mousterian. So long ago as 1925–1926 the existence of this 35-m. lake was discovered by us and its Mousterian age noted (*Journ. Roy. Anthrop. Inst.*, vol. 56, 1926, p. 314).

ORIGIN AND PHYSICAL CONSTITUTION OF THE EARTH

THE EARTH: ITS ORIGIN, HISTORY, AND PHYSICAL CONSTITUTION. 2nd Edition. By HAROLD JEFFREYS. *Cambridge University Press* 1929. 11 × 7 *inches;* xii + 346 *pages; and diagrams.* 20*s*

THE publication of a second and largely rewritten edition of this now well-known book is an event of great interest not only in the somewhat limited field of geophysics, but also in the wider realms of geology and geography. The first edition was a welcome and stimulating volume, characterized throughout by sound physics, brilliant mathematics, and an unusually lucid style, in which a pioneer attempt was made to give a connected account of the origin of the Earth, its thermal history, and its present mechanical status. As far as was then practicable, all the hypotheses advocated were quantitatively confronted with observational data, and whether or not one found the hypotheses acceptable, one's admiration was aroused by the logical beauty and ingenuity of the deductions. Meanwhile, in the five years that have elapsed, more data have become available, Jeffreys himself having been indefatigable in thus putting parts of his book out of date, and the call for a new edition has now given an opportunity for incorporating the recent advances and revising the whole.

The book is considerably enlarged; 278 pages becoming 346, plus three plates, and though there is a corresponding increase in price, the book is still remarkably cheap. The chapter on seismology is doubled in length and more

than doubled in value, for here progress has been both rapid and fruitful. Seismology now follows the chapter on the age of the Earth and precedes one dealing with thermal problems: this constituting a change of order that may be noted as a minor though real improvement.

The opening chapters on cosmogony remain practically as they were, but it may interest readers to turn to a recently published paper in which Jeffreys develops the theory of actual material collision between the sun and a star, and shows that "it provides directly quantitative explanations of the total mass of the planets and their rates of rotation, and of the rate of rotation of the sun" (*Monthly Notices R.A.S.*, May 1929). The chapter on the age of the Earth is thoroughly up to date and is a model of scientific exposition. In its broader aspects this subject may now be said to have passed beyond the stage of controversy, for even Joly has now been converted to the validity of the higher estimates based on the testimony of radioactive minerals. Just where the age of the Earth lies between say 1600 and 3000 million years does not greatly matter; the important point is that there is no longer any ground for adhering to the formerly fashionable estimate of 100 million years.

Seismological observations on near earthquakes have given a new impetus to the study of the hidden structure of the Earth's crust, and here controversy is still very active. In 1909 A. Mohorovičić discovered the waves denoted as $\bar{P}$ and $\bar{S}$ or P_g and S_g. These are interpreted as waves that have travelled through the upper or granitic layer of the continental crust, and they have since been detected by Jeffreys and Wrinch and by Gutenberg and others. In 1925 Conrad recognized the wave P^*, a compressional wave transmitted with a velocity intermediate between that of P_g in the upper layer and that of P in the lower layer or substratum. Its existence has been confirmed by Jeffreys, who has also identified the corresponding distortional wave S^*. The presence of an intermediate layer which transmits P^* and S^* is thus proved, at least for Europe and California. Jeffreys presents convincing reasons for regarding the thicknesses of the upper and intermediate layers respectively as about 10–12 km. and 20–25 km. There are indications that the thicknesses are not the same in Central as in Western Europe. S. Mohorovičić has given a different interpretation leading to higher estimates which have been widely quoted. Jeffreys discusses this fully, and suggests that the observational data used by Mohorovičić were inadequate. Recent investigations by Gutenberg and Byerly definitely support Jeffreys's estimates, and it may be added that thermal considerations based on the radioactivity of the rocks have always seemed a fatal objection to the thick granitic layer advocated by Mohorovičić.

The velocities of the three sets of compressional and distortional waves provide limiting evidence of the nature of the three layers. The upper layer is clearly granitic or gneissic—as we observe it to be beneath the superficial veneer of sediments. The lower layer transmits waves with velocities consistent with its identification as dunite or eclogite (a possible high-pressure facies of basaltic material). The intermediate layer may similarly be identified with basaltic glass or with diorite or quartz-diorite. Jeffreys favours the former, and the reviewer suggested the latter as a more probable alternative. Direct evidence, contributed by the xenoliths brought up from great depths by the peridotite magma of the diamond-pipes of South Africa, suggests that neither identification is right, at any rate for that part of the world (P. A. Wagner, *S. Af. Journ. Sci.*, 25, 127–148, 1928). The chief materials actually brought up in addition to granitic and gneissic rocks are amphibolites, granulites, eclogites and peridotites. The composition of the eclogites does not correspond with that of the plateau-basalts, and the eclogites cannot therefore be regarded

as their source. As no data exist at present for the velocities of earthquake-waves in the African crust, it cannot be regarded as certain that there is an intermediate layer beneath Africa. If there be one, however, it may be permissible to suggest that an interfoliated mixture of granite-gneiss and amphibolite would meet the requirements as well as quartz-diorite, and this may well be the nature of the intermediate layer elsewhere.

The alternative assumption of a basaltic layer in a glassy state is considered by Jeffreys to receive further support from the numerical coincidence that the radioactivity of 10 km. of average granite and 20 km. of average basalt would just about suffice to make good the Earth's loss of internal heat. One serious objection to the existence of such a layer is that it nowhere goes sufficiently deep to reach a temperature that would make possible the eruption of plateau-basalts. Jeffreys gives the temperature as 300° C. at the top and 650° at the base, and thus a rise of a few hundred degrees would still be necessary to promote vulcanism. Jeffreys thinks a rise of 100° might be sufficient (p. 297), basing this estimate on the fact that the normal temperature of the deeper lava at Kilauea is 750°–850°. There is, however, ample evidence that plateau basalts have generally issued at higher temperatures than these. Daly also requires a glassy substratum, and in his case he places it at such a depth that the temperature is adequate for vulcanism. Unfortunately, the seismological evidence provides no place for basaltic glass except at the depths selected by Jeffreys. Thus in neither case is the assumption of a layer of glassy basalt acceptable. It is much more probable, as Bowen has pointed out in chap. xvii of his 'Evolution of the Igneous Rocks,' that the magmas of the great flows of plateau-basalt have been generated from the peridotite-like material of the lower layer. Bowen favours the derivation of basaltic magmas from the selective fusion of already crystallized peridotite, while the reviewer thinks it more probable that they may be residual magmas produced by the fractional crystallization of glassy peridotite. It is in any case no longer essential from the petrological point of view that there should be a basaltic layer beneath the continents.

The treatment of the thermal history of the Earth is considerably modified, and it is pointed out that a uniform distribution of radioactive matter would keep the interior fluid below a thin outer shell until the processes tending to concentrate the radioactive elements upwards had brought about the present enrichment of the upper layers in these elements. A revised theory of cooling by conduction is then given. The reviewer, however, finds in the new discussion no reason to modify his frequently expressed opinion that this theory, for which he was originally responsible, fails to give a satisfactory picture of the Earth's thermal behaviour. He would suggest, on the contrary, that the upward concentration of the radioactive elements is still far from complete, and that the method of cooling advocated by Jeffreys has as yet barely begun in the lower layer. The production of basaltic magma from the peridotitic material of the lower layer, and its eruption at the surface, is a method of concentrating radioactivity upwards that has been operating throughout geological history. All basalt contains uranium, thorium, and potassium, and therefore its presumed parent, the peridotite of the lower layer, must also be radioactive. If basaltic material had been separated once and for all at an early stage of the Earth's history, then the oldest basalts should be more radioactive than the youngest ones. Precisely the opposite is the case. These considerations suggest that in the depths of the Earth cooling is still proceeding by convection in material which, though rigid enough to transmit seismic waves, is still too hot to have crystallized to any considerable depth.

Jeffreys has faced this alternative thermal theory in advance by two lines of evidence which, it must be confessed, appear at first sight to be fatal to its acceptance. These indicate that the deeper parts of both the Earth and the moon have sufficient strength to make impossible a circulation of material by convection. The first depends on the figure of the Earth and its relation to isostasy. Jeffreys accepts Heiskanen's systematic variation of gravity with longitude. This corresponds to an excess of material about the longitudes of Central Africa and Hawaii, and a complementary deficiency about those of the Andes and Sumatra. The departure of the equator of the geoid from a circle "is far too large to be explained by any compensated inequalities, and must apparently be attributed to a real imperfection of isostasy" (p. 222). Such a widely distributed load implies, of course, very deeply situated stress-differences, and these in turn imply the possession of considerable strength by the "asthenosphere." This deduction, if valid, is so fundamentally important for theoretical geology that it is to be hoped that geodesists will give it their careful attention to see if any other interpretation of the observational data be possible. There is one geological argument suggesting forcibly that the interpretation given by Jeffreys may not be final. If Africa has this bulge—and it appears to be quite genuine—then clearly, in accordance with the delicacy of isostatic readjustment elsewhere (for example, in Scandinavia), it ought to be a dominantly subsiding area. On the contrary, there have been surprising changes of level in Africa since the Cretaceous, and the Tertiary uplift is apparently still going on. What is the process responsible for this uplift, and how has it pushed Africa up beyond the level of isostatic equilibrium? Does it not seem that some deep-seated process is operating which is actively preventing equilibrium? Jeffreys's argument presupposes static conditions; but if the real conditions be dynamic, then the present form of the geoid equator may be a misleading guide to the strength of the interior. Elsewhere, too, the conditions are dynamic. The Hawaiian region is sinking, as it would be expected to do. The Andes and Sumatra belts, on the other hand, are rising areas, as they should be in response to their alleged departures from isostasy.

The second line of evidence alluded to depends on the observed large differences between the moments of inertia of the moon. These are explained by Jeffreys on the hypothesis that the moon "solidified when much nearer the Earth than it is now, and has maintained the figure it had then." To do this "the moon's interior must have a strength comparable with that inferred for the earth's asthenosphere, and its permanence in the moon gives strong reason to believe that it is also permanent within the earth" (p. 231). Here again the only way out of the difficulty seems to be the possibility that the moon's external form is maintained in part by the activity of internal currents. The clear indications of violent volcanic activity do not, in any case, seem consistent with a moon so dead that a fossil tide could have persisted through hundreds of millions of years of geological time. Whatever processes within the Earth are attributable to radioactivity should be still more vigorous within the moon, if the theory be true that the material of the moon came from the flanks of the ancestral Earth. The sharply defined features of the lunar craters are in accordance with this deduction, and moreover, they suggest that the last great outbursts of igneous activity took place not long ago in a geological sense.

Geographers will turn with interest to the chapter dealing with "The Origin of the Earth's Surface Features." The thermal-contraction theory of mountain building is re-stated in the light of the modified cooling theory, but the attempt to answer adverse criticisms is incomplete, and does not face the difficulty that geosynclines may be opening and subsiding in one part of the world while

mountain building is going on in another. However, an important contribution to the interpretation of the history of mountain ranges is made. Jeffreys summarizes the various stages of the latter as follows (pp. 295–296):

"1. Compression of the crust, with thickening of the sedimentary, granitic, and intermediate layers, elevation of the surface, and outflow in the lower layer.

"2. Sculpturing of the outer surface by denudation, with deepening of the valleys and slight rise of the highest ground. This process leads to the maximum of relief.

"3. Outflow of matter from the intermediate layer, with compensating inflow in the lower layer. The region sinks, and denudation becomes less active. The valleys are by this time so deepened as to undergo no further denudation, and further erosion is confined to the mountain-tops.

"4. Final stage, when the whole is worn down. Old sedimentary rocks and possibly the granitic layer are exposed. The granitic layer is probably thicker, and the intermediate one a great deal thinner, than at the commencement of the process.

"The time taken in the first stage is of the order of a million years, the second 30 million, and the third 300 million."

This clear recognition of the importance of flowage in the deeper parts of the crust is a welcome innovation, for hitherto the theoretical Earth of Jeffreys has seemed too hidebound and constricted to indulge in such internal activities.

But this flicker of vitality is not enough. No attempt is made to explain the origin of geosynclines or oceanic deeps—though it is suggested that the latter (when formed) may be supported regionally—and the reviewer fails to see how such features can be explained at all if the Earth has reached the stage of contracting as a result of cooling by conduction. Such considerations as these, and others arising out of mountain building, igneous activity, and the distribution of the continents, make it difficult to accept the thermal history and its limited consequences as developed by Jeffreys. To borrow an extravagant simile from Samuel Butler, the Earth of Jeffreys is like a pot egg: it won't hatch out.

So much of the book is masterly in treatment and outlook, representing throughout a remarkable co-ordination of the data of every branch of geophysics and geochemistry, that it may seem ungrateful to close on a note of adverse criticism, even though this applies only to the frankly speculative decorations of an otherwise imposing structure. But Jeffreys has clearly invited it, for he heads a too superior polemic on "The Relation of Mathematical Physics to Geology" with a caption beginning, "If you make some compliments to a man about that which he knows he does well, that is no good. But if you praise him for what he do pretty dambad, then you give him a great pleasure." Most of the book is done well, and apart perhaps from the references to Professor Joly, which some may consider discourteous, none of it is "pretty dambad." Those who explore it thoroughly will find it an inspiring example of scientific architecture, and however they may react, according to their experience and habit of mind, they will feel impelled to admire the skilful handling of the material.

ARTHUR HOLMES.

REVIEWS

THE ARCHAEOLOGY OF THE CHANNEL ISLANDS. In 2 vols. Vol. I. THE BAILIWICK OF GUERNSEY. By T. D. KENDRICK. *London: Methuen & Co.* 1928. 10×8 *inches;* xxiv+274 *pages; illustrations, maps and plans.* 25*s*

The Channel Islands have played an interesting part, on a small scale, in the maritime life of Western Europe in past times, an important factor having been, as Mr. D. Trevor Williams has shown in his articles in the *Transactions* of the Société Jersiaise and the Soc. Guernesiaise, that they have afforded refuge roadsteads and ports of call to small ships. They had this function already in fairly early mediaeval times, and it is hence possible that some such function may have been theirs already in prehistoric times, when, about the dawn of the Bronze Age, they seem to have had quite extraordinary importance. This volume describes the megalithic monuments, with their contents, for Guernsey and its dependent islands, and is based on the work of Lukis, Gosselin, Lee and de Guérin as well as on that of its author. The fact that de Guérin mentioned over sixty great stone monuments apart from menhirs, and that a fine museum is filled with objects of high quality from them, suggests an importance altogether out of proportion with the island's area of 24 square miles. Kendrick is probably right in suggesting that the megalithic culture of Guernsey continued after the fashion had died out on the mainland. This persistence of distinctive features is often noticed in islands which, with perhaps different transmarine relations in their different parts, may show remarkable diversities in a small compass. The second volume, to deal with Jersey, will probably show that in the matter of megaliths Jersey and Guernsey differ markedly, but each has a sort of unity of its own. In the case of Guernsey we are clearly dealing with a northern outpost or agency of the contemporary civilization of Le Morbihan, S. Brittany. Beaker pottery, forms of the Gallery Dolmens, and many other features demonstrate this, and suggest that the link with Finistère, in S. Brittany, is far less close. Jersey has perhaps more suggestion of links with Finistère, as well as with lands farther north.

Brittany is, on a large scale, an intermediary between Copper and Bronze Age Cultures on the one hand of the Iberian Peninsula and Western France, and on the other of Ireland and West Britain, and, in a remoter degree, the West Baltic. Finistère has northward links, Morbihan southern ones; Guernsey, therefore, at the time was in a measure the northernmost post of the south-west European maritime culture of the Copper and Early Bronze Age. H. J. F.

A GEOGRAPHY OF THE BRITISH ISLES. By A. MORLEY DAVIES. Second edition. *London: Macmillan & Co.* 1929. 8×5 *inches;* xii+358 *pages; illustrations, maps and diagrams.* 3*s* 6*d*

THE HOME OF MAN. PART I, THE BRITISH ISLES. By W. C. BROWN and P. H. JOHNSON. Revised edition. *London: George Harrap & Co.* 1929. 8×5 *inches;* 330 *pages; illustrations and maps.* 3*s* 6*d*

THE BRITISH ISLES: A comprehensive Guide on new and improved lines. Fourth and enlarged edition. *Cheltenham and London: Ed. J. Burrow & Co.* [N.D.] 8×5 *inches;* vi + 312 *pages; maps and plans.* 3*s* 6*d*

Of small school geography books there seems to be no end. Dr. Morley Davies' little book, judging from the number of issues, evidently enjoys considerable popularity and satisfies a demand. In its treatment of the subject and its method of illustration it is certainly superior to many of the school geography books that are published. The geological side is dealt with at greater length than usual, and

its bearing on the different regions of the British Isles clearly explained. The numerous little maps are well chosen, very clear, and instructive.

In 'The Home of Man' attention is concentrated on the coalfields as affecting the life of the inhabitants of the British Isles. The descriptive text is constantly interrupted by questions in leaded type, a method which will certainly arrest the attention, and possibly stimulate the interest of the student, if it does not improve the style of composition.

Messrs. Burrows' publication is essentially a gazetteer, illustrated with maps, and is apparently, partly at least, an advertisement of the White Star Line of steamships which is largely responsible for its appearance.

DEVON. By S. E. WINBOLT; illustrated by photographs by EDGAR and WINIFRED WARD. *London: G. Bell & Sons* 1929. 7×4 *inches;* 1+270 *pages; and illustrations.* 6*s*

The compilation of a county guide-book is not a thing to be lightly undertaken. To be properly adequate it requires many years and many miles of personal exploration; otherwise there are bound to be copyings and omissions. Instead of the several new series now being produced we should prefer to see the old handbooks revised and brought up to date. This "Pocket Guide" to Devon does not profess to be complete; it certainly has omissions. There is, for example, no account of Lapford Church with its remarkable screen, though this place is close to a main route; nor of Embury Beacon (south of Hartland), which is not only one of the highest cliffs on the whole coast—515 feet at the edge—but is also crowned with a well-defined and notably placed cliff-fort. The author, however, is obviously an archaeologist and gives a list of the ancient monuments scheduled by the Commissioners of Works. His derivations of place-names are not always very definite or convincing; of Bideford he says that it is a corruption of "By the ford," hints that " ford " may mean road (which would be Celtic) or fiord (which would be Norse), and later on admits that the ford which preceded the famous bridge may be the origin of the name. The photographs are artistically taken but sometimes hard in reproduction. Clovelly was probably considered too hackneyed a subject. Of this place the author says, "One wonders why slates have not been replaced on the roofs by good-weathering red tiles." There spoke a man of Sussex. J. H. R.

PASS-STAATEN IN DEN ALPEN. By ALBRECHT HAUSHOFER. *Berlin-Grunewald: Kurt Vowinckel* 1928. 8×5 *inches;* 200 *pages; and sketch-maps.* *M.*10

This is a study in the historical and political geography of some of the chief Alpine passes, and of the small states which grew up along or near to them from the twelfth to the nineteenth centuries. The area concerned extends from the St. Bernard to the Brenner; and the author makes only incidental reference to the rest of the Alpine Lands.

The location of the Alps decides that the north–south routes shall be of much greater importance to through traffic than those along the Alpine belt; though the latter have had considerable political importance as internal links among the small states which became grouped into the Swiss Confederation and the Austrian provinces of Tirol and Vorarlberg. Among the north–south routes, that across the St. Gotthard was for long the most important, and it formed the axis of the typical pass-state of Uri which at its maximum extended completely across the mountain zone from the Lake of Lucerne to Maggiore and Lugano. The close limitation of the study to the Alps prevents the author from making useful reference to changes in remoter lands which have from time to time

modified the relative importance of some of the trans-Alpine routes; so that some such changes in importance appear without explanation.

The lands of the High Alps can be conveniently grouped into three zones of altitude, though the actual altitude of the transition from one to another of these varies considerably with local conditions. At the top is the *Anökumenische Hochregion*, of no direct use to man, next is the *Alm-region* of alpine pastures and meadows used only in summer, and below this is the *forest zone*. Farther down lies the inhabited land of the valley floors and the lower slopes, mostly below the 2000-metre contour but rising much farther in a few sheltered valleys or on favoured slopes. This permanently habitable land necessarily includes all the bases of the Alpine states; and it is because of the narrowness of their lowland bases that the pass-states proper have been finally absorbed by those of the foreland; that, for example, Uri and Graubünden are of much less importance than Bern and Zurich.

Most of the important passes lie in the Alm-region, though the Brenner hardly rises above the forest belt; and the political divisions of the Alm-region were naturally determined by its accessibility from below and not by its water-partings and crests, which are often somewhat indefinite, especially in the passes. The valleys up which the ways go are usually interrupted by abrupt breaks of slope, the valley-steps, which have given rise to difficult gorges in marked contrast to the open valleys above and below. Well-known gorges of this type are those of Schollenen on the Upper Reuss and the Via Mala on the Hinter Rhine. The valley-steps occur at various altitudes, but very largely in the forest zone or near the lower edge of the Alm-region. Thus the customary use of the pasture, and with it the effective possession, of the Alm-region fell to the people of that valley settlement who could best reach it, and their boundary was pushed forward to the valley step on the farther side. These boundaries appear to have been determined during the settlement of the inner Alpine valleys in the early Middle Ages, and during the mediaeval period of developing trans-Alpine intercourse many groups of such valley settlements grew into small states. Those which found themselves in control of important through-ways became what the author calls pass-states, and owed their relatively greater wealth and power to the exploitation of the route and its through traffic. Successful pass-states, such as Uri, Savoy, Graubünden, and Tirol, extended their rule across the mountains to include the chief approaches to their passes from both sides. It is to be noted that side by side with the pass-states similar states in side-valleys, such as Glarus and Unterwalden, remained small and insignificant in their isolation.

The author lays great stress on the difference in value between single passes, such as the St. Gotthard and Brenner, and double passes, such as the Gemmi-Simplon and the Albula-Bernina, where it is necessary to climb over two chains in order to cross the mountains. But, as he shows very well, the real difficulty in transit is rarely at or near the summit of any pass: it occurs at the valley-steps, and the relative difficulty of routes over passes of similar altitude depends much more on the number and character of their steps than on the number of pass-summits. It is significant that the boundaries usually intersect the routes at such steps. It is rather the exception than the rule for a long-standing boundary to cross an important through-way at the summit. In this way Switzerland holds the southward slopes of most of the chief passes into Italy, including the Simplon, Septimer, Maloja, Bernina and Ofen, as well as all those leading into the Ticino.

The volume is well documented and illustrated by useful sketch-maps, which, however, need to be supplemented by the use of a good orographical map. It is a valuable contribution to political geography, and it is capable of adding interest to both recollections and anticipations of a visit to the Alps. C. B. F.

THE NAPPE THEORY IN THE ALPS (ALPINE TECTONICS, 1905–1928). By Dr. FRANZ HERITSCH. Translated by Prof. P. G. H. BOSWELL. (Methuen's Geological Series.) *London: Methuen & Co.* 1929. 8×5 *inches;* xxx+238 *pages; illustrations, diagrams, and maps.* 14*s*

English-speaking students of mountain building have good reason to be grateful to Professor Boswell for his admirable translation of 'Die Decken theorie in den Alpen.' Professor Boswell is well equipped for what must have been a formidably difficult task, for he has studied Alpine geology at first hand during many climbing expeditions, and he has shared adventures and discussed the problems of Alpine tectonics with several of the leading European investigators of this tormented volume of the "rocky book of earth." On the appearance of Heritsch's well-proportioned review of the nappe theory, he recognized it as an unusually fair-minded presentation of a highly controversial subject. Stimulated by the suggestion of Professor J. W. Gregory that an English edition would be welcome, and by the willingness of Messrs. Methuen to publish it in their Geological Series, he has completed the translation, bringing it up to date in collaboration with the author, and adding a glossary and also many new figures and illustrations. Thus has been produced a book of which all concerned may be proud, and for which our sincere congratulations are abundantly due.

The particular merits of the book are its success in giving a balanced statement of the development of the subject through a maze of often divergent views; in pointing out where contradictory interpretations are due to obscure relationships in the field; and in drawing attention to evidence that is incompatible with the more extreme hypotheses and generalizations. This restoration of a sense of proportion has long been needed. The book is necessarily compressed and involved in parts, and these must be read slowly with the aid of good maps. It would be futile to anticipate the possibility of a simple treatment; overwhelming complexity is inherent in the subject itself. It follows from this that few English readers would have the patience to wade through the original German. Not only has Professor Boswell made the way easy for others, but he has made a real contribution to tectonic nomenclature in the glossary with which the book now begins. This is primarily an aid to reading, but in addition it is a guarantee of the reliable translation of an exposition which technically presents great difficulties in any language; furthermore, it helps to remove a tantalizing source of mental friction in the reading of other German contributions to the subject.

The fundamental idea of the present tectonic conception of the Alps is that great sheets of rock, or *nappes*, have been thrust from the inner towards the outer border of the Alps, and the question over which controversy continues to be active is the extent to which the nappe theory is true. The first clues came from the recognition of the *klippes* (*e.g.* the Mythen) as sculptured relics of a sheet of Triassic and Jurassic formations which had been thrust forward over the younger but underlying Flysch. In 1894 Schardt adopted this conception as the key to the interpretation of Alpine tectonics as a whole, and showed that the klippes could be correlated with still greater "rootless" sheets of rock. Already in 1875 Suess had realized that the front of the Alps had been thrust over the Tertiary deposits of the European foreland and that the original shore-line must have been farther south, that is, underneath the present outer margin of the mountains. In recent years Ampferer has developed this deduction. At the same time he has found good evidence telling against the older assumption that nappes are drawn-out recumbent folds, and favouring the alternative view that they are thrust slabs which have themselves been locally rolled into folds.

It is admitted by all the geologists who have worked in the Alps, Lugeon, Termier, Heim, Staub, Argand and many others, that the nappes imply dis-

locations of gigantic dimensions. The Alps are indubitably a product of compression, and therefore the width of the belt of sedimentation before folding and thrusting occurred must have been much greater than that of the resulting mountains of the present day. Unravelling the 6 km. of the Säntis gives an original width of 18 km. For the Helvetic zone a reduction in breadth from 180 km. to 60 km. has been estimated by Heim; and for the Pennine zone a reduction from 300 km. to 80 km. These figures give a good idea of the order of compression involved in the production of Alpine structures, but they provide no justification for the assumption that certain of the nappes are parts of Africa thrust over Europe. Heritsch is careful to avoid all such extravagant figures of speech, and with justice, for it is only common sense that the term "Africa," which denotes a well-defined geographical area, should not be used simultaneously to mean both Africa and Africa plus a hypothetical northern border which may or may not have formerly existed before the present Mediterranean came into being.

It is not yet known to what extent individual nappes extend along their strikes. The great difficulties of correlation have been well pointed out by Heim. Although it has often been thought that each nappe is characterized by a certain sedimentary facies by which it could be recognized, this cannot be regarded as established, for there may be rapid changes of facies along the strike as well as from one nappe to another. Failure to recognize such possibilities of facies variation has been responsible for many hypotheses now found to be untenable relating to the extension of nappes laterally into the Eastern Alps, and backwards into the difficult region where "roots" are sought. Heritsch makes it clear that these two problems are still far from a satisfactory solution. In 1903 Termier made a great advance when he interpreted the Tauern and Lower Engadine as "windows" exposing to view the rocks of lower nappes, and framed by the denuded edges of higher nappes. The western limit of the latter (where the Helvetic and Pennine nappes plunge beneath as a result of their pitch towards the east) has been regarded as a recessed erosion border, but alternatively an east–west compression, giving transverse thrusts, has been advocated. Correlations on the two sides of this border are further confused because in the west mineral reconstruction (metamorphism) went on concurrently with the differential movements, whereas in the east, as the rocks had already been recrystallized and become rigid, they responded by breaking into slab- or tile-like blocks which moved forward one over another, producing imbricate structure. If the east–west compression did not occur a very serious dilemma has to be faced, for then there must have been great piles of nappes—reaching in all a thickness of 30 km. in the Ticino—out of the lower members of which the present mountains have been carved by denudation. Yet the corresponding material removed by the agents of denudation is nowhere to be found, and morphological evidence shows the persistence in the topography of ancient land-forms of Lower Miocene and greater age. The missing accumulations of debris may have been overridden by the advancing Alps, but old land-forms could not have persisted if later nappes had been driven across them. In view of these and other difficulties which Heritsch clearly brings out, we can but suspect with Professor Boswell "that the theories of our present fruitful years have possibly outrun the facts." A. H.

OUR FOREFATHERS, THE GOTHONIC NATIONS: a Manual of the Ethnography of the Gothic, German, Dutch, Anglo-Saxon, Frisian and Scandinavian Peoples. By G. SCHÜTTE. Volume I. Translated by JEAN YOUNG. *Cambridge: University Press* 1929. 9×7 *inches;* xii+288 *pages; and maps.* 21*s*

This work, as its subtitle indicates, is an investigation of the ethnography of the Gothic, German, Dutch, Anglo-Saxon, Frisian, and Scandinavian peoples. The author claims originality for his mode of treatment of this complicated subject under the headings of Names, Subdivision, Ethnic Position, Environment, Old Home, Language, Civilization, and History: he justly points out that ethnography suffers from the want of uniformity of arrangement in the descriptions of nations by different writers, thus making comparison difficult. He makes no such claim for his material, which in dealing with so wide a subject is enormous, and may well appear to be beyond the power of any one single author, and must inevitably be open to criticism.

Although he considers it cumbersome and awkward, he accepts the term Indo-European for the stock from which the Gothonic nations are derived, but he is not ready to subscribe to the popular theory that the Gothonic stock is identical with the Nordic. "We have no kind of guarantee whatever," he remarks, "that our stock has not already absorbed various diverging types of race in remote antiquity."

The subject of Environment is treated at considerable length; in fact, nearly a third of the book is given to it. The different neighbours of the Gothonic nations, classified as Indo-European and Foreign, are described, and their civilization compared with the Gothonic. The neighbours who attract most attention are the Itali and Celts. The question of the original home of the Celts, and the mutual relations of Celtic and Gothonic civilization, are discussed at length. In the Hallstatt and La Tène periods the Celts were the chief disseminators of materials for Gothonic civilization. In later times the Celts borrowed much linguistically and culturally from the Gothonic nations. The Romans were the only Italic nation that came within the Gothonic range. Rome by her conquests checked Gothonic expansion across Europe, and after the Romanization of the frontier countries from the English Channel to the Black Sea, the Romans took the place of the Celts as purveyors of Gothonic culture, and were themselves exposed to Gothonic influence. The great number of loan words of every kind of cultural significance show Roman influence. A long chapter on Language is largely a dissertation on Names—tribal, family, place, cosmic, of gods, spirits, and men. The value of the short simplex which lies at the basis of the development of language as "root" is emphasized, and monosyllables are regarded as a sign of antiquity in Scandinavian languages, e.g. primitive vegetation, oldest Gothonic family names, ancient place-names, old water names, cosmic names, and names of spirits and gods.

Where was the old home of the Gothonic nations? The author refuses to enter upon the perennially debated topic of the primaeval home of the Indo-Europeans as a whole, and contents himself with tackling the question of the home of the European part of the stock. In this view obviously the home was in Europe. All legends and migration stories agree in placing the home in the north. They remember nothing except that there have been movements from north to south. Origin from Scania is confirmed by complementary evidence, *e.g.* the tribal and river names of Scandinavia are all short simplexes, whereas Germany and other lands have long derivatives in greater number. The historical evidence is confirmatory, for it shows that all migrations since 200 B.C. have flowed from north to south. Any migration in the opposite direction is clearly a return home.

But now comes the further question: What was the source from which the Gothonic nations reached Scandinavia? The distribution of the word "sea" suggests that the Itali, Celts, and Gothonic peoples once dwelt together by a north European sea, and that the name for sea in the primitive language was "mare." The oldest Gothonic vocabulary shows a very close connection with that of the Itali and Celts. Archaeological evidence, Megalithic tombs and low mounds with single graves in Scandinavia, the former originating from the south-west by sea, the latter from the south-west over land, suggests two ways of migration by both of which the Gothonic peoples may have reached the north from a common Itali-Celtic base. Although only conjectural, it is in this direction that the evidence points, and "there is nothing among the Gothonic nations that points beyond this, and brings us into connection with an original home near the Carpathians, or a steppe between Europe and Asia." Many details regarding Gothonic civilization are given in a rather disjointed way, but much ground is covered, and we are informed regarding the Constitution and Social system, the Classes of the Community, the Family, Trade, Handicrafts, Runes, Navigation, and Religion.

Several different classifications of the history of the Gothonic nations have been suggested: (*a*) An early period of Pagan antiquity, followed by a later period of Christian times; (*b*) The well-known archaeological division into the three Ages of Stone, Bronze, and Iron; (*c*) An extension of (*b*) under six heads: Old Stone Ages, Megalithic period, Celtic Iron Ages, Roman Iron Age, Migration Age, Viking Age. The author offers a modification and elaboration of this in recognizing eight phases: (1) A West European phase, corresponding with the time when, as already mentioned, the Gothonic people lived with Itali and Celts by a north-western European coast; (2) a Finnish phase, contemporary with the Jutish low mound graves at the end of the Stone Age; (3) an East European phase, connoting the movements across the Baltic, and east to the Black Sea by which the Gothonic nations came in contact with the more Eastern Indo-Europeans; signs of this are seen in trade routes for amber on the Prussian coast, the spread of the Mycenaean spiral and Dipylon style of ornament; (4) the Continental Celtic phase, characterized by two important ethnic factors; the Celtic migration from Gaul, 500–300 B.C., and the expansion of the Celtic Iron Age during the Hallstatt and La Tène periods, the civilization of which exercised a profound influence on the Gothonic nations and continued to be felt after the political downfall of the Celts; (5) the Roman phase; (6) the Hunnish phase, which saw the culmination of the great migration; but the Huns were a negative factor in Gothonic history and civilization—the mutual relations between Gothonic and Roman civilization continued undisturbed throughout this phase; (7) the Slavonic advance, which seems only sporadically to have affected the Gothonic nations, but Gothonic influence on Slavs, Baltic peoples, and Finns was constantly spreading if the evidence of loan words is to be relied on; and (8) the British phase, which is another name for the Viking Age. Although the sphere of the Vikings was enormous, extending from America to Asia, their winnings were uncertain, and constantly exposed to retrogression. Normans in France were soon romanized, Northmen in Iceland and Scotland were celticized. In Russia and Wendland they were absorbed by the Slavs. But the slavonized retreat was followed by the Germanization of large Slav districts, and the spread of commerce, craftsmanship, and agriculture.

The Gothonic continental area has changed little since. Anti-Gothonic changes are seen in the absorption of the Crimean Goths by the Tartars in the seventeenth and eighteenth centuries, the Italian reaction pushing back Germanization in Northern Italy and Southern Tyrol in the thirteenth century, the

Hussite reformation acting similarly in Bohemia, in the fifteenth century, and similar changes in Poland, Bohemia, and among the southern Slavs in the nineteenth and twentieth centuries. On the other hand Pro-Gothonic changes are illustrated by the dying out of Cornish British and Irish Gaelic, the spread of Dutch in the East Indies and South Africa, of English in Australia, North America and Africa. Also in the adoption of Gothonic language by foreign races, as *e.g.* Yiddish by the Jews, Dutch by Kaffirs and Hottentots, of English by American negroes, so that at the present time the Gothonic-speaking peoples number some 250 millions. Detailed references to authorities are given throughout the book, which, if destitute of style, often disjointed, and not too easy to read, contains an immense amount of learned, useful, and interesting material which will well repay careful study by all interested in Ethnology and History. There is an admirable index of more than thirty pages, and several maps.

E. A. P.

HOW TO OBSERVE IN ARCHAEOLOGY. Suggestions for travellers in the Near and Middle East. Second Edition. *London: British Museum* (*Quaritch*) 1929. 7×5 *inches;* 120 *pages; illustrations and diagrams.* 2*s* 6*d*

This is a revised edition of a useful little publication first issued by the British Museum in 1920. Its object is to give all interested in archaeology essential information on a number of subjects which will enable them to make the best use of any opportunities for archaeological observation or discovery they may meet with, and to avoid careless or desultory treatment of sites or objects found. In the first part Sir Flinders Petrie gives a series of instructions regarding the methods that should be adopted. Useful hints are given on Outfit, Recording, Planning, Drawing, Copying, Photographing, Preservation, Packing and Marking of objects. In the second part some essential and fundamental information is given on Stone Age Implements, and on archaeological remains which have been, and may still be, found in Greece, Asia Minor, Cyprus, Syria, Palestine, Egypt and 'Iraq. In this part there are forty-five illustrations, with more than three hundred figures, showing typical examples of implements, weapons, pottery and scripts. In an Appendix a brief account is given of the Laws of Antiquities prevailing in the different countries—Greece, Turkey, Cyprus, Egypt, Palestine, and 'Iraq—where archaeological research is being so largely prosecuted at the present time. It is remarkable what a large amount of information and advice is contained in this little volume, small enough to be easily slipped into the coat pocket.

E. A. P.

KARTE ZU G. MERZBACHERS REISEN IM MITTLEREN UND OSTLICHEN TIAN-SCHAN 1902–03 UND 1906–08. Scale 1 : 500,000 (1 inch to 7·89 stat. miles). *Munich* 1928. 8 *sheets, each* 14×13 *inches*

Professor Dr. Gottfried Merzbacher died at Munich in April 1926, and amongst his papers were found, as the results of his expeditions in the years 1902–3 and 1907–8, fifteen unpublished maps of the Central and Eastern Tien Shan, on the scale of 1 : 100,000. Dr. Merzbacher had taken the precaution of bequeathing, against his chances of leaving his work unfinished, a legacy to the Bavarian Academy of Sciences with the wish that they would carry on the task. The result is this very fine series of eight sheets covering a large and little-known region of the Central Tien Shan, for which our only guide before was the Russian 40-verst series, on the inadequate scale (for a mountainous region) of 27 miles to an inch.

The region covered is roughly that from Kuldja (in the Ili Valley) and the culminating peak of Khan Tengri in the west, to Manas and Kurla in the

east: a mountain block of roughly 300 miles by 150. The maps are on the scale of 1 : 500,000. They clearly distinguish between the regions actually explored by the Merzbacher party and those areas which have been added from Russian sources. There is a key-map to show those portions taken from the Russian 40-verst series. These maps also show what there is left to do; in the way of alpine exploration—sufficient to tempt any one, especially in the vicinity of Khan Tengri. Panoramic photographs, inserted in the blank portions of the sheets, add largely to their value and interest. The altitudes are in metres, barometrical readings by the expedition, or from other sources. Incidentally we note the height of the apex of the whole Tien Shan range is still undecided; but it would appear that Khan Tengri is *under* 23,000 feet. D. C.

OM MANI PADME HUM. Meine China und Tibet expedition 1925/28. By WILHELM FILCHNER. *Leipzig: F. A. Brockhaus* 1929. 9×6 *inches;* x+352 *pages; illustrations and map. M.*15

Doctor Filchner is already known as a Central Asian explorer, and one who has added greatly to our knowledge of this part of the world. The main object of his expedition in 1925, which lasted some two and a half years, was purely scientific, namely, to fill in the gaps which remained in the astronomic-magnetic surveys of Central Asia. The author succeeded in establishing a chain of magnetic stations of observation between Tashkent observatory and Koko Nor. It was further intended to fix a parallel line of observations extending from Koko Nor to Kashgar, but this project unfortunately had to be abandoned. Doctor Filchner on his return spent some time at the Geodetic Branch Office of the Survey of India standardizing his instruments and plotting out his route on the Survey of India maps. The final results are being compiled in Berlin, and these will be awaited with the greatest interest.

'Om Mani Padme Hum' is an account of this expedition, but does not deal with the scientific data, as it is intended for the general reader. The book is for the most part in the form of a diary, and was no doubt largely written up at the time. There are therefore some obvious repetitions, which however do not detract from the general interest of the book. One of the most striking features is the determination shown by Doctor Filchner in the face of apparently unsurmountable difficulties and hardship. One can safely say, however, that even with his indomitable courage, had he not had previous experience of travelling in Central Asia he would not have survived to tell the tale.

Doctor Filchner set out early in January 1926, unaccompanied by any European, travelling via Moscow and Tashkent. He entered Sinkiang, or Chinese Turkistan, at Kuldja and followed a route across the Gobi to Subsi and then straight on through to Kum Bum near Koko Nor. At Koko Nor Filchner met two European travellers who were heading for Shigatse. At the time Filchner was short of funds and provisions, and the fact that he had suffered considerable hardships and deprivations no doubt made him wisely decide to join forces with these travellers. This unfortunately entailed abandoning his original idea of the fixing of a parallel line of observations. The party of three then obtained a passport from General Ma, and in May 1927 left Koko Nor, reaching Nakchuka, 150 miles north of Lhasa, on 10 September 1927. The road to Lhasa and Shigatse was here barred by Tibetans, who compelled the party to turn westward towards Ladakh, which was reached about the middle of February 1928. The part of the journey through Nakstang followed the route mapped out by Sir Henry Hayden's expedition in 1922, though at the time Filchner's party was unaware of this fact.

'Om Mani Padme Hum' can be described on the whole as a first-class travel

book, full of human interest. The German publishers are to be congratulated on the general production of the volume. There is one drawback: the type is Gothic. Any book of such widespread interest as this should surely be printed in Roman type. The book is illustrated by many photographs, has an excellent map, and a full index. It is to be hoped that some enterprising English publisher will bring out an English translation of this work. B. K. F.

DIE ALAI- (PAMIR-) EXPEDITION 1928. Deutsche Forschung. Aus dem Arbeit der Notgemeinschaft der Deutschen Wissenschaft. Heft 10. 1929. 196 *pages;* 2 *maps. R.M.*10.

This is a preliminary report of the work of the Alai-Pamir Expedition of 1928, a general account of which was given by its leader, Mr. W. Rickmer Rickmers, at an evening meeting of the Society last spring (see *G.J.*, 74, 1929, pp. 209–231). The expedition was organized by the Notgemeinschaft der Deutschen Wissenschaft and received the support of the U.S.S.R. Academy of Sciences. The present account shows that important additions were made to the knowledge of the area. For example, the geologist, L. Noth, shows that the country consists of a base of crystalline schists and phyllites, above which are beds with a few Middle Devonian fossils. They are succeeded by Jurassic sandstones and conglomerates with plants, and Herr Noth did not find in them any of the marine fossils previously discovered. Marine Upper Cretaceous and some Eocene and glacial beds complete the succession. The geographical bearing of the geological work is that the author shows that the Devonian beds have been overthrust on to the Upper Cretaceous, which in some places rest directly on the Devonian without any evidence of disturbance, while the overthrusting seen in the eastern and western parts of the Trans-Alai Range is not present in the central part of the area. He concludes, therefore, that the Alai and Pamir Mountains belong to the same system. The main glaciers are all in retreat, but a few minor glaciers are readvancing down some of the side valleys. The volume has been promptly prepared as a preliminary report, and the lines of the sections are not stated, so that they are not readily intelligible. The fuller account of the expedition may be expected to make a material contribution to knowledge of the mountains of this part of Turkistan. J. W. G.

THE EFFECT OF WESTERN INFLUENCE ON NATIVE CIVILISATIONS IN THE MALAY ARCHIPELAGO. Edited by Dr. B. SCHRIEKE. The Royal Batavia Society of Arts and Sciences. *Batavia: G. Kloff & Co.* 11×7 *inches;* viii+248 *pages*

At the Congress of the Pan-Pacific Association at Tokyo in 1926, a Committee for the study of Anthropology was decided upon, and Dr. B. Schrieke, Professor of Sociology of the Faculty of Law, Batavia, was invited to accept the position of Chairman, to marshal and co-ordinate the knowledge of experts and to submit the same for discussion by the Association at future Congresses. Dr. Schrieke's nearest available field of operations being the Netherlands Indies, he set to work there, and the first result of his labours is this valuable treatise made up of contributions from erudite individuals of long experience amongst the peoples of Dutch East India.

In order the better to show the effects of Western influence on the civilizations of the Oriental races dealt with, the writers dwell upon the origin and degree of such civilizations at the time of the first coming of Europeans into the Archipelago. They then describe, each in his own department, the nature of the foreign influence, the methods of its introduction and gradual extension, and the manifestations at present resulting therefrom. And finally some of them

advance their views as to the future of the peoples so wrought upon. Thus there is prepared for consideration by the Association, and incidentally for the public edification, a mass of highly instructive anthropological, historical, ethical, economic, and other detail connected with the inhabitants and the administration of the Dutch East Indies.

The nature of the civilizations found in different parts of the Malay Archipelago and the degree of foreign influence that has been brought to bear on them vary greatly. At one extreme are the Sundanese and Madurese of Java, highly civilized by centuries of contact with Hindu and Arab culture, and now, after four hundred years of Western influence, as enlightened a community as any in the Orient; and at the other the Bahau, Punan, and their like, unsophisticated tribes living as their forefathers lived a thousand years ago and subjected, only since the day before yesterday, as it were, to such Western influence as may be exerted by an occasional missionary or the rare visits of a peripatetic minor official.

The collaborators have dealt fully with every aspect of their subject, including an unbiassed exhibition of the motive forces of the Dutch Domination and the disadvantages as well as the advantages of foreign contact for the indigenous races. Every chapter has its problems of compelling interest in the reactions of the Oriental, sometimes most unexpected and disconcerting, to the inculcations of the Occident; the development of language, the conflict of laws, the astounding growth of the Javanese population under conditions of slavery (from four to thirty-seven millions in a century), education, the Eurasian question, and others.

The final chapter, by Dr. Schrieke himself, a summing up of the evidence that has gone before, contains significant matter. The effects, in many ways stupendous, of Western influence are well and thoroughly established; but the thoughtful reader is left in doubt at the end as to how far the sum of human happiness may ultimately prove to have been increased thereby. The administration is working now to secure the benefit to the people of a great material progress achieved under a quite different incentive, but the psychic forces that have come to birth during the process of material evolution threaten to stultify the work. Dr. Schrieke's dissertation on the "Inferiority Complex" may be recommended to all concerned with Oriental affairs.

The destiny of this book for the uses of the Pan-Pacific Association explains its appearance in the English language. Though the translators have had occasional idiomatic difficulties and the printer is at moments in trouble, it is as readable as it is instructive, and is worthy of the Royal Batavia Society of Arts and Sciences under whose auspices it is produced. W. A. G.

SCIENCE IN THE NETHERLANDS EAST INDIES. Edited by L. M. R. Rutten. *Amsterdam: Koninklijke Akademie van Wettenschappen (De Bussy)* 1929. 11×7 *inches;* viii+432 *pages; illustrations, maps and diagrams*

This book is a compilation of articles written by Dutch authorities on various aspects of science in the Netherlands East Indies. It was prepared and published for the benefit of visitors to the Fourth Pacific Science Congress, with the financial support of the leading scientific institutions in Holland, the Netherlands Indies Pacific Research Committee (of which Dr. Rutten is secretary) being responsible for the preparation of the work. Except that the English translation leaves much to be desired, there can be nothing but praise for this interesting compendium of exact information, and besides fulfilling admirably its primary purpose, it will be of great value to the student as a work of reference. The subjects dealt with include Anthropology, Botany, Zoology, Agricultural

Research, Jurisprudence, Language and Literature, Geology, Earthquakes, Volcanic Science, Hydrography, and Geography, Dr. L. van Vuuren's long paper on the "Geographical Aspect of the Netherlands East Indies" being particularly valuable. O. R.

VOYAGES TO THE EAST INDIES. By CHRISTOPHER FRYKE and CHRISTOPHER SCHWEITZER. With Introduction and Notes by C. ERNEST FAYLE. (Seafarer's Library.) *London: Cassell & Co.* 1929. 9×6 *inches;* xliv+276 *pages; and illustrations.* 10*s* 6*d*

The two German worthies, the tale of whose travels in the East Indies in the latter half of the seventeenth century is reprinted in this volume, were not in themselves of great importance, nor have they anything very striking to tell us. But these narratives are of interest for two reasons. Firstly, they travelled in the East at a time when the domination of the Dutch, though still firmly established, had just begun to decay, and many of the reasons for this decline become clear in this volume. Secondly, very little has appeared in England on the times and work of "Jan Compagnie," John Company's great rival, and these voyages show us very clearly " the other side of the hill." In a scholarly introduction Mr. Fayle sketches the development of the Dutch Company and has some interesting observations to make on the financial and administrative questions concerned. Some of his remarks on shipping, however (pp. xxi–xxxvi), are of doubtful value, and he would have done better to have consulted contemporary Dutch works, such as Van Dam's monumental History of the Company now in course of publication in Holland, than second-hand English works. His statement about the *Hondewacht* is not altogether accurate. It occurs in Dutch writings considerably earlier than 1680—for example, in Tromp's journal of 1639—and extending from midnight to breakfast it was not the same as the English dog watch, which some authorities derive from "docked watch." Of more value are his comparisons of the rations issued on board Dutch and English Indiamen (pp. xxxvii–xl), which are most interesting.

The book is well printed, except for a few misprints in proper names (*e.g.* Hulst for Hulft, and Spielman for Speelman), and well produced, and, as we have already said, the Introduction is a refreshing contrast to many of those provided in works of this nature. The two German originals to which the Editor refers are, the reviewer believes, to be included by Messrs. Nijhoff in the Collected Edition of the works of XVIIth-century German Travellers which is being prepared for that firm by Heer S. P. L'Honoré Naber. C. R. B.

RESULTATI SCIENTIFICI DELLA MISSIONE ALLA OASI DI GIARABUB (1926–1927). Fasc. i, ii and iii. *Rome: Reale Societa Geografica Italiana* 1928. 11×8 *inches;* viii+442 *pages; illustrations, maps, and diagrams*

A very painstaking account of the geology of Jaghbub is the result of the first scientific investigation of the area. The three parts are respectively devoted to the general configuration, geology, and palaeontology of the country visited from the Mediterranean littoral, between Rael Melh and Sollum, to the depression of Jaghbub. Unless further publications are envisaged, the title is a little misleading, since geographical, historical, and archaeological subjects, quite apart from botany and zoology, are not dealt with: the theme is purely geological.

The geographical bearing of the work is confined to the first part, where the structure and formation of Coastal Marmarica, the Marmarican Plateau, and the Jaghbub section of the North Libyan depressions are described. From his investigation of that particularly interesting section of coast north and south of Port Bardia, the author of this first part concludes that the land surface and

plateau behind were formed by emergence. There are signs of faulting along the coast where the marine terraces may represent a fault face raised above sea-level by intermittent stages. There appears to have been little fracture on the Marmarican plateau itself, but its gentle slope southwards and the east and west trend of the Siwa-Jaghbub depressions, which may in themselves have been created along the line of a further fault, tend to confirm the conclusion regarding the coast. The authors point out that the data collected are still wholly insufficient to warrant more than very tentative conclusions of so general a nature.

Except for the heliogravures of geological specimens, and microphotographs which are a great credit to the publishers, the Royal Italian Geographical Society, the illustrations leave much to be desired. Numerous sketches and diagrams accompany the text, but the maps which the expedition must have helped to compile have been omitted from these volumes. F. R. R.

ECONOMIC HISTORY OF THE UNITED STATES. By H. U. FAULKNER. *New York: The Macmillan Company* 1928. 8×5 *inches;* xiv+302 *pages.* 6*s*

This clearly written little book is "designed primarily for adult readers who may not have had the time and opportunity to pursue the subject in greater detail." It is thus a compact series of elementary essays rather than a systematic text-book. The selection of material is good, and there are useful reading lists. The book should achieve its purpose. The work is of small compass, but, though there is evidence that the author is aware of the geographical factors in American History, this aspect of the subject receives practically no attention. Ll. R. J.

THE DISCOVERIE OF THE LARGE AND BEWTIFUL EMPIRE OF GUIANA. By Sir WALTER RALEGH. Edited from the Original Text, with Introduction, Notes and Appendices of hitherto unpublished documents, by V. T. HARLOW. *London: The Argonaut Press* 1928. 11×8 *inches;* cvi+182 *pages; maps and portrait.* 36*s*

A HISTORY OF BARBADOS, 1625–1685. By V. T. HARLOW. *Oxford: Clarendon Press* 1926. 9×6 *inches;* xviii+346 *pages; and maps.* 21*s*

This admirably produced edition of Ralegh's celebrated narrative is much more than its title indicates. Of 255 pages exclusive of index only 85 are occupied by a verbatim reprint of the first edition of 1596 and explanatory footnotes. The remainder is devoted to appendices and a modestly titled "Introduction," which is in reality a valuable contribution to the history of the Elizabethan Age and to the story of geographical discovery.

In his volumes of voyages to Guiana and Jamaica in the early seventeenth century published by the Hakluyt Society, and in his ' History of Barbados,' Mr. Harlow has already proved his familiarity with the comparatively ill-explored period that followed the classic days of English maritime adventure, and he now carries back his freshness of outlook to place one of the most celebrated of the adventurers in his true setting. Ralegh's biographers have made him the subject of such uncritical eulogy as to disguise his real place in the history of his time, and a valuable feature of the Introduction is the space devoted to an estimate of Ralegh and especially to the nature of his contribution to geographical discovery. The Ralegh here depicted is recognizably the real man and not the impossible paladin of earlier writers. The partizans of the generation after his death held him up as the pattern of Protestant and anti-Spanish zeal, and writing at a time when national hatred of Spain was being fanned afresh for another war, they claimed that he had fallen a victim to Stuart tyranny because he strove to vindicate against a pro-Spanish king English rights to a share in the New World. Too often their propaganda has been taken at its face value, and it

is welcome to find that at last a version of the story has appeared in which the Spaniards are given a fair deal. In his Appendices Mr. Harlow prints from the Spanish archives a selection of unpublished material relating to the Guiana expedition and the kingdom of El Dorado for which it was searching, that is of great interest. The papers belong to a collection that has been used by other scholars, but not for this purpose. They were transcribed from Simancas and the Archivo General de Indias at Seville in preparation for the British case against Venezuela in the Guiana Boundary Arbitration in 1898, and were presented by the Foreign Office to the British Museum. The story that this new evidence reveals brings Ralegh's attempt into the direct line of descent from the Spanish conquistadors, and we can trace much of his inspiration to its source in the emulators of Cortez and Pizarro.

To set the stage properly for Antonio de Berrio, the captain against whom Ralegh fought and whom most of the newly published papers concern, we have a succinct critical account of the growth of the El Dorado legend and the long and tragic efforts of the Spaniards to find a new Peru in the depths of the American forests. It was in the course of many unsuccessful expeditions that the basins of the Orinoco and the Amazon were explored, and this summary forms a useful addition to the history of discovery. For more than forty years adventurers had vainly sought for a rich and civilized kingdom in almost every region between the coast of Venezuela and the banks of the Amazon, and in 1580 only one region, Guiana, remained unsearched. It was in this region that Berrio, the last contributor to the legend, was convinced that the city of the gilded man was to be found, and these documents prove conclusively that it was from him that Ralegh derived the idea which he made famous. Berrio has hitherto been a shadowy figure of whom little was known save from Ralegh's pages, but we can now realize that he was one of the greatest of South American travellers and that to him is undoubtedly due the localization of the legendary kingdom in the highlands of Guiana. Ralegh appears to have recounted with great accuracy what he learned, but Berrio completely deceived him as to the extent of his knowledge and attainments. Through Quesada, whose niece he married, he was directly connected with the earlier searchers, and thus we are now able to trace the whole growth of the legend. Many difficulties and apparent contradictions that have baffled previous writers from Humboldt onwards are now solved by a piece of careful scholarly work that deserves a high place in the literature of the subject. A. P. N.

THE LIFE AND LETTERS OF SIR HARRY JOHNSTON. By ALEX. JOHNSTON. *London: Jonathan Cape* 1929. 8×6 *inches; 352 pages; portrait and illustrations.* 12*s* 6*d*

Only six years ago Sir Harry Johnston published 'The Story of my Life' in a volume of over five hundred pages, full of controversial topics, but handled for the most part in a very good temper: with a rich display of his enormous versatility, energy, and disbelief that any one who differed from him on any subject could possibly be right; indiscreet and petulant and full of contempt for people who spelled Muhammad any other way or believed in a classical education; but full also of the childlike enthusiasm that were the charm of the man, and giving a thoroughly interesting and tolerably impartial account of the East African scene in which he had played the leading part. If it was necessary to add biography to autobiography, the task might well have been left to some friend with knowledge and ability to make a kindly critical study of his brilliant but erratic gifts.

Unhappily, as it seems to us, his brother has undertaken to "supplement, not to supersede" the autobiography by a volume of Life and Letters that has pro-

voked certain reviewers to an assault upon the memory of our Gold Medallist, past Vice-President, and old friend. The Letters, relatively few, and some of them written in sickness or disappointment, add little to what has been told at leisure and in retrospect in the autobiography. The Life is a sad example of unsuccessful eulogy. "While still only twenty-seven, his *bons mots* passed from mouth to mouth in a society which perhaps has never been surpassed for its selective hostesses . . ."; "The next week-end he was asked to Hatfield, much to the chagrin of a highly placed official in the Foreign Office"; "Just for once Harry allowed a shot to break the peace of Eden. A monster male fell, and for the first time the Five-horned Giraffe was revealed to science"; and "W. T. Stead quoted him on many subjects as the decisive authority." These random examples display the wide range of injudiciousness with which the book is written. As a source book for history the work is of doubtful value. Take, for example, the curious incident during Sir Harry Johnston's governorship of Uganda as a Special Commissioner, when the head of the African Department of the Foreign Office came out to inform himself of the success or otherwise of the Governor's new policy. In the autobiography the rival bishops, the officer in command of the troops, and the ruling chiefs were invited "to meet him—and me." In the biography they were summoned to a " secret conference," with the implication that it was held behind the Governor's back. The former seems the more probable action, even for an "elderly Permanent Official with permanent prejudices and limitations." Or take again the choice of site for a capital. Sir Harry chose a glorious place about 8000 feet above sea, but says explicitly that the East Africans preferred Nairobi, 2000 feet lower: the Life says that "my brother's choice was overruled by officials who had never seen the country." On his hard treatment in the matter of pension Sir Harry wrote quite enough: it was left for his younger brother to complain that a retiring Speaker of the House of Commons was given six times as much.

The whole tone of the Life does its subject's memory a grave disservice; but rarely we are grateful for an illuminating story. In 1889 in Nyasaland, "my brother displayed for propaganda purposes a most effective colour scheme, which never failed to appeal to those with whom he wished to make treaties whatever race they might belong to. He displayed on his hat band, his writing-paper, in his house decoration, and in any other convenient way, parallel bars of black, white and yellow. In British Central Africa, and afterwards when I was with him in Uganda, when a conference opened with black men or yellow (Asiatics), he would show them their own share in his tricolour and extract from it the parable that the colour lines in Africa were parallel, not contrary, in direction and aim. . . . My brother even went so far as to advocate a flag for the whole British Empire on these lines, since there are far more coloured than white men in our league of nations." In 1900, when the High Commissioner was travelling to Ruwenzori and the Congo, he insisted as always that his staff should dress for dinner. "But the white shirt was only a part of Harry's symbolism. In Africa, when his Secretaries' day's work was done, there was still a use to which their bodies could be put. They represented so much available advertising space—some more, some less—for the exhibition of his Black, White and Yellow inter-racial policy. The first two colours of his tricolor were already exhibited in their conventional evening dress; but for the third he imposed upon them yellow waistcoats."

It would seem that such methods were not always appreciated by superior officials, who get called pompous dullards and demigods of Downing Street; some of them may even have been among those traducers, whose corns of pomposity, ineptitude, and fawning deceit Stanley had trodden upon, while an

absentee speculator-King played for his own hand amidst a swirl of cross-currents. But we have quoted enough to show the sad results of a practical education under his own supervision, of which Sir Harry speaks so complacently in his autobiography.

TRAVELS AND REFLECTIONS. By the Rt. Hon. NOEL BUXTON, M.P. *London: George Allen & Unwin* 1929. 9×6 *inches; 224 pages; and illustrations.* 10*s*

In this interesting book we have a worthy companion to similar travel sketches by the late Lord Bryce, in his 'Memories of Travel,' and by Mr. Douglas Freshfield, in his delightful 'Below the Snow Line.' The author's descriptions of the varied types of scenery through which his wanderings took him reminds us of some of Mr. Freshfield's happiest moods, while his reflections upon the serious side of the politics and social upheavals in the Near and Middle East recall the penetrating insight and shrewd judgment of Lord Bryce. It was to this great statesman and distinguished traveller that Mr. Buxton largely owed the inspiration which sent him forth on the quest ultimately leading to the formation of the Balkan Committee of which he was for many years the chairman and moving spirit.

Not the least interesting passages of the descriptive portions of Mr. Buxton's book are those which deal with the influence of geographical environment upon the character and fortunes of the people about whom he writes. In this respect the chapter on "The Balkan Hills," with which he has had so intimate and adventurous an acquaintance, is of special value, nor is the opening chapter, "Among the Kurds," less illuminating. Warm as were his sympathies with the Balkan peoples in whose best interests he worked long and earnestly, he never allows his sympathy to cloud his judgments of their deficiencies.

In spite, too, of his well-founded disapproval of much that he met with in Turkey and of the corruption that characterized much of Turkish life, he can speak of these without bitterness, even when he himself at last became the victim of a Turkish fanaticism that almost cost him his own life and that of his brother.

In the chapter on "War" we have a description of the writer's experiences as an agent of relief in the Balkan War of 1912. The instances given of the stolid indifference of the Balkan soldiers to pain, in spite of severe suffering, afford an interesting parallel to the fortitude which has always been such a striking characteristic of the Japanese in similar circumstances.

One of the pleasantest chapters is that in which the author describes, among his experiences of "Mountaineering in Japan," a journey entirely off the common routes of tourist traffic at the time when it was made, and under conditions of an unusual character. The exciting descent of the turbulent rapids of the Tenriugawa in Central Japan and the unique experience of an ascent of Fuji-San over the yet unmelted snows of winter, after a three days' imprisonment on its lower slopes by the typhoon sent by an offended mountain divinity in punishment of alien sacrilege, are graphically told. The humours of the *basha*—the native springless country 'bus; the naïve incredulity of the remoter country-folk who denied the existence of any human beings save those dwelling within the boundaries of "Great Japan"; and, still more, the quaint and often startling variety of the bathing customs that prevailed at so many of the thermal springs in the country districts remote from the beaten tracks—all is exceedingly entertaining. We are grateful to Mr. Buxton for a book of unusual interest and charm. W. W.

UNFREIWILLIGE REISE UM DIE WELT, 1621–28. By CHRISTOPH MATHIAS FERNBERGER. Ed. by E. VON FRISCH. (Alte Reisen und Abenteuer, 22.) *Leipzig: F. A. Brockhaus* 1928. 8×6 *inches; 159 pages; and illustrations. M.2.80*

This narrative is printed from an unpublished MS. in the Salzburg *Studienbibliothek*. It is there attributed to one C. M. Fernberger von Egenberg, of whom nothing else is known. This family, however, held a certain position in Austria, some of its members being travellers and writers. The circumstances of Fernberger's voyage and his stay in the East Indies are rather baffling, for no record of the fleet with which he sailed has been discovered, nor does he give the name of the commander or other officers. Despite all this, and the character of his escapades, the editor asserts his belief in the genuineness of the narrative, and hails Fernberger as the "first Austrian circumnavigator."

Yet a comparison of the events of the voyage from the west coast of Africa to the Philippines with that of Oliver van Noort's voyage of circumnavigation of 1598–1601 establishes the strong probability, if not certainty, that Fernberger drew upon the latter for his material. At two points, the editor comments unfavourably on Fernberger's narrative. The first is the decision, when off the coast of South America, to return for water and supplies to Saint Helena. This the editor thinks improbable, and in fact the proposal was not carried out. In Van Noort's journal a similar decision in the same circumstances is recorded, and this attempt to reach Saint Helena likewise failed. The second is Fernberger's description of the inhabitants of the island of La Mocha, off the Chilean coast. His editor remarks that La Mocha is described in other accounts as uninhabited: yet in Van Noort's journal the description closely resembles Fernberger's. It might be urged that Fernberger refers to the Straits of Le Maire, which his editor believes he passed through, while Van Noort sailed through the Straits of Magellan. Fernberger's account of this part of the voyage is by no means clear, but it contains statements which reflect Van Noort's description of his passage of the Straits of Magellan.

The editor seems to have overlooked the name "Cabo Deseado" for the north-western termination of Desolation Island : he assumes throughout that it refers to Porto Deseado, several hundred miles north of the eastern entrance to the straits, and this influences his opinion on the route described. He has also been unable to identify the island of "Prara" mentioned in the text: it is possible that this results from a confusion with, and corruption of, the name "Praia vermelha," the anchorage at Rio de Janeiro.

The itinerary, as far as the island of Capul in the Philippines (Fernberger spells it Capuk), closely follows that of Van Noort: this, and the resemblance between the incidents on both voyages, is surely more than accidental, and shakes belief in Fernberger's dangerous and far-flung adventures in the East. It is easier to accept him as a forerunner of Defoe, than as a follower, at however respectful a distance, of Magellan and Drake. G. R. C.

THE MONTHLY RECORD

GILCHRIST STUDENTSHIP

The Gilchrist Trustees again offer, for 1930–1931, a Geography Studentship of £80, tenable at any recognized School of Geography, with a view to the furtherance of improved teaching of Geography in schools. Applicants, who should be teachers with at least two years' experience, should send in their names to Prof. Lyde, Yew Garth, Sandhurst, Berks, before 2 February 1930; they must give references and a full account of their previous work, and their applications should be accompanied by three testimonials. Further particulars may be obtained from Mr. H. A. Matthews, 7, Priory Avenue, High Wycombe, Bucks.

SANDBANKS OFF YARMOUTH AND LOWESTOFT

An interesting historical sketch of the vicissitudes to which these sandbanks have been subject in the past two or three centuries is given by Dr. H. Muir Evans in the *Mariner's Mirror* for July last. Besides the knowledge of the subject derived from a study of early charts and records, the writer has the great advantage, as a yachtsman, of a close personal acquaintance with that part of the East Anglian coast in its present condition. Visitors to Yarmouth or Lowestoft will remember the long line of sandbanks actually visible in the offing at low tide, which have always formed a serious impediment to navigation, and so rapid are the changes that the channels by which access to those ports is afforded at one period may within a few years be so blocked by sand that they have to be abandoned in favour of others, imposing a serious task on the authorities responsible for the guidance of sailors by the provision of lights and buoys. The changes in quite early days were more extensive than anything known in modern times, affecting the actual outline of the coast, for there is evidence that the Yare once entered the sea by a huge estuary, the site of Yarmouth being merely a sandbank at its mouth, as represented in the "Hutch" map supposed to date from about 1000 A.D. The succession of later charts begins with the 'Mariner's Mirror' of Waghenaer (English edition, 1586), in which the "Holmes before Yermouth" are shown as four evenly spaced banks with widish passages between. (Dr. Evans notes that there are also "Holmes" behind Yarmouth, the present Cobham Island being a corruption of Cobholm, while St. Benet's Holm is now dry land.) The four banks correspond to the present Holm, Corton, St. Nicholas and Scroby Sands, in succession from south to north. Dr. Evans traces the subsequent changes by the help of Seller's 'Coasting Pilot,' Mount and Page's chart of 1746, Norie's 'Sailing Directions for the North Sea' (1826), and the later official charts, giving sketch-maps of the arrangement of the banks at different periods. That between 1860 and 1875 was one of great change, while further shifting of the banks took place in 1912 and 1922. For details, the original paper must be consulted. Dr. Evans has some interesting notes on the nomenclature of the banks, tracing the derivation and original meaning of terms like "Knowles," "Knapes," "Skull," "Scalp," and "Owers." The first is of course connected with knoll, and the second is regarded as a variation of the same root. Skull and scalp (as also head) seem to represent the idea of a bowl, while owers is derived from the Anglo-Saxon ora, "shore." Lemon (used in conjunction with owers for two parallel banks) is shown by an old MS. to be connected with *limber*, itself derived from the French *limon*, a shaft. Dr. Evans cautions the reader against derivations from the names of fish or birds (sole, whiting, gull, etc.), lemon in the above case having no connection with lemon soles. May not there be a connection, however, in the reverse direction, the fish being so named from the banks where it is caught? We are glad to know that Dr. Evans is continuing his researches on the banks of the Essex and Kent coasts.

THE PALM GROVES AND TOWN OF ELCHE, S.E. SPAIN

In the *Zeitschrift* of the Berlin Geographical Society (5/6, 1929) Dr. O. Jessen describes the geographical environment and history of the "Palm wood" and town of Elche, on the south-eastern Spanish littoral, in which there are some details of the present state of that unique area. The *Vega* of Elche remains the only one in Spain where dates are grown on a large scale, and where cultivation is almost entirely confined to date palms. The "desert-steppe" of the seaboard around Elche having little or no supplies of ground water to be tapped, and the rainfall being irregular, cultivation depends entirely upon irrigation. The water is obtained from the Vinalapó, which is dammed above Elche, and its entire flow utilized. The main canal feeds twenty-one smaller canals, from which the water is distributed by ditches over the individual holdings, the total discharge being 360 litre-seconds. The practice of auctioning the water each morning, under traditional rules, is still maintained. The "palm wood" is more strictly a plantation: the palms line the ditches, and the intervening rectangular fields are cultivated. After dates, pomegranates and barley are the important crops, but beans, artichokes, alfalfa, oranges, etc., are also grown. In the immediate neighbourhood of Elche there are at present about 80,000 palm trees: *circa* 1880, there were less than half this number, but the number has now ceased to increase. The dates are inferior in quality to those of North Africa, and are mainly consumed in Spain, the crop being worth on an average 200,000 pesetas. The industry is preserved only by the exceptionally favourable climate: the dry atmosphere, hot winds, and cloudless skies secure the ripening of the fruit, and compensate for the somewhat lower average temperature during the growing months than that of North Africa. The relatively small quantity and salty nature of the Vinalapó water have led to the concentration upon the date palm.

The history of Elche centres largely about the struggle to secure the water of the Vinalapó. Although they had obtained a royal privilege, the citizens were unable to prevent towns upstream from drawing off the water. As some protection against this, the dam was built: in 1793 it was destroyed by a sudden flood, but re-built later. As well as economic troubles, the town suffered from political disturbances: its industrial life was particularly hard hit by the expulsion of the Morisco element at the beginning of the seventeenth century. The present site of the town was selected by the Moors with an eye to the possibilities of irrigation. At the reconquest the original small walled town was occupied by the Spaniards, who permitted the Moors to establish a quarter several hundred yards to the south, and to cultivate land across the river. Three other "quarters" grew up later: a settlement of "llamadas" between the first two: the "Puebla San Jorge," in 1439, to the north-west, and the Jewish quarter to the east, of the Moorish. Thus the city remains a disjointed cluster within the bounding rectangle, and its history may to a considerable degree be traced in its street plan. Elche had in 1920 a population of 30,000. Dr. Jessen also describes briefly the small waterless island of Plana, or Nueva Tabarca, which lies off Santa Pola, and formerly served as an advanced post for Elche.

SURVEY OF THE ITALIAN ISLANDS IN THE AEGEAN

Although maps (of a sort) of various Aegean islands were produced in Italy in very early days—some MS examples dating from the fifteenth century—no really satisfactory survey of those now under Italian control had been carried out down to the present day, though the British Admiralty charts supplied the data for the coast features. An elaborate survey by modern methods has now been inaugurated by the Italian authorities and an account of the work so far done is given by Sig. Giuseppe Gianni in *L'Universo*, Anno X, Num. 7 (July 1929). It was pro-

posed to undertake the topographical mapping of the whole group of islands on the scale of 1 : 25,000, and in April 1922 the Survey of Rhodes was begun, the work being entrusted to the Istituto Cartografico Militare of Florence.

The position of the northern extremity of the geodetic base and of the azimuth of the latter was rigorously determined by the Hydrographical Institute of the Italian Navy near the radio-telegraphic station at Sand Point (Cum Burnu), and the trigonometrical connection made with the triangulation. The base, for which a site in the south-east of the island was chosen, was measured by the Jäderin method. Other operations were the determination of mean sea-level and of the coefficient of refraction, the triangulation being at the same time put in hand and the topographical survey commenced, in the first instance on the scale of 1 : 20,000. In 1925 similar work was started in the island of Cos, where observations for latitude and azimuth had been carried out the year before by the Hydrographical Institute. Topographic surveys have been also executed in the other lesser islands, and it is hoped to continue the work until a precise survey of the whole group is available. The paper gives full details of the methods adopted, together with tables embodying the results obtained. Specimen sheets of the maps are also given.

MOUNDS ON THE COLUMBIA RIVER PLATEAU

The frequent occurrence of small natural mounds as a surface feature of many parts of the United States has long perplexed physical geographers, especially because such mounds seem to be met with nowhere else in equal abundance. A discussion maintained in *Science* in 1905, suggested by a paper by Mr. A. C. Veatch at the Biological Society of Washington early in the same year, was summarized in the *Journal* for the following August (vol. 26, p. 219), and soon afterwards elicited a paper from the late Prof. Schwarz on a similar feature observed by him in Cape Colony (*Journal*, vol. 27, pp. 67 *et seq.*). The mounds of the Columbia river plateau have lately been examined with some care by Messrs. A. C. Waters and C. W. Flagler, who give the results of their study in the *American Journal of Science* for September 1929. They begin by mentioning the many different hypotheses put forward to account for the origin of such mounds in different parts of the country, those which have attracted most attention being no fewer than thirteen. The suggested causes include glacial or wind action, chemical segregation, deposits round springs or formed by animals, differential weathering and many others. The writers, like others who took part in the discussion in 1905, consider that such mounds in general are due to a variety of agents, but conclude that those on the plateau in question are all a product of surface erosion. In this they agree with Joseph Le Conte, who, partly from a study of the mounds recently examined by the writers, came to a similar conclusion so far back as 1874, though his views have not met with general acceptance. Le Conte considered that the special conditions necessary for the formation of the mounds were a treeless country and a drift-soil consisting of a fine and more movable layer above and a coarser and less movable one below. Surface erosion cuts through the upper layer, but leaves portions as mounds. The present paper records the field observations which support this conclusion, illustrating by photographs the various stages in the initiation and development of mound topography. The careful measurements taken reveal the significant fact that even when appearing circular to the eye, the mounds are almost invariably elongated in the direction of slope.

LEON PANCALDO, A COMPANION OF MAGELLAN

As in all the great voyages of the Age of Discovery, the crews of the vessels of Magellan were reinforced by a considerable number of Italian sailors, the total being placed at twenty-two or twenty-three, most of them from that nursery of

sailors, the Ligurian coast. Foremost among them was Leon Pancaldo, of Savona, whose important part in the voyage as pilot and cartographer is attested by contemporary documents. A careful biographical notice of this man has lately been published by Sig. Filippo Noberasco (Savona, 1929), who has kindly sent us a copy of the brochure. It begins with a sketch of the political events which, while prejudicing the fortunes of Genoa in the fifteenth century, left Savona relatively immune, so that this city then reached its golden age of prosperity, alike in arts and industries, and in nautical enterprise. The writer quotes early documents and writings to show that Savona must then have possessed regular nautical schools, and an authority qualified to grant the title of "Capitano di Mare" to those who had passed through them with distinction. The importance of the place is shown by the fact that even in the fourteenth century it could boast of forty-six "great ships," and the number had much increased in the fifteenth, when its naval contractors reached the high number of forty. The city was thus well fitted to give birth to a capable navigator like Pancaldo. Not much is known of his early life, and the year of his birth is not certain, though probably 1482. Whether, like other natives of Savona who are known to have sailed with Columbus, he took part in voyages to the New World before joining Magellan, cannot be decided with certainty, though certain indications point that way, and he must no doubt have gained a reputation as a skilled navigator before gaining a place in the great voyage of circumnavigation, for there is reason to think that, even if not a regular pilot from the outset, he was a good deal more than an ordinary seaman. Sig. Noberasco traces, so far as is possible, his experiences during the voyage, which latterly were anything but fortunate, as he was not one of those who completed the circumnavigation in the *Vittoria*, but shared in the trials and hardships which befell the crew of the *Trinidad*, though he ultimately made his way back to Spain. The writer discusses the vexed question of the actual position occupied by Pancaldo in Magellan's voyage, and pieces together the subsequent events of his life down to his somewhat mysterious death, possibly during a last voyage of discovery, soon after 1535. When all allowance is made for the enthusiasm of a compatriot there remains little doubt of the considerable title to fame possessed by the subject of the memoir.

THE DRY LAKES OF SOUTH AUSTRALIA

The Lake Eyre Basin and surrounding district north of Spencer Gulf in Australia has been passing through its seventh year of the worst drought recorded by the inhabitants. Very little is known of the dry lakes of Australia, and until recently no one had succeeded in crossing the district, some 250 miles by 150 miles in area, north of Lake Eyre. In the search for *The Southern Cross* early in this year certain aerial observations were made of the region, and *The Southern Cross* itself on its return journey from the Kimberleys to Sidney in April reported the presence, in the unknown area north of Lake Eyre, of a large unsuspected dry lake into which the Finke river apparently flows in time of flood. The whole region was found to be sandy desert. In *The Times* for September 25 and October 1, Mr. S. Upton describes the dry lakes in the light of recent investigations, which include his own visit this year to the southern end of Lake Torrens. This part of Central Australia received in the past far heavier rainfall than it does at the present day, and was occupied by large fresh-water lakes, fed by perennial streams. Since Jurassic times, when the principal lake was probably 1200 miles long by 700–800 miles wide, there has been a series of lakes whose deposits it is believed may contain rich mineral salts. The general geology of the district is fairly well known, and some of the smaller lakes have been worked for salt, but no deep borings have been made and no deposits of value yet discovered. The

levels and contours of the lakes are still practically unknown, and the extent of the water, if any, in them is uncertain.

Aerial observation early in July reported Lake Torrens, which has an area of 2230 square miles, to be covered with water only in patches in the centre. The elevation of the lake-bed which is known to slope westward, has only been fixed due west of the railway line between Meadows station and Edeowie, where it has been found by levelling to be 108 feet above low water at Port Augusta. Willochra Creek is the chief source of surface supply. No outlet to the lake is shown on Government maps, but Mr. Upton states that in January of this year a continuous channel, said to have been made by the Willochra flood of 1921, lead from the south-east corner to Spencer Gulf. From evidence on the ground he maintains that Lake Eyre and two lagoons which lie west of the channel were once joined to Lake Torrens at a common water-level. Owing to climatic and other changes they gradually became separated until Lake Eyre flowed in time of flood into Lake Torrens over a spillway now not more than 175 feet above sea-level, and Lake Torrens into the lagoons over a spillway now from 100–120 feet above sea-level, scouring a channel in quartzite and slatey rock. Then overflow from Lake Eyre ceased and that from Lake Torrens cut a way to the east, which, with increasing dryness, like the other channels became choked with sand.

Lake Eyre North, 2970 square miles in area and 40 feet below sea-level, is known to be fed through peculiar mound-springs by waters of the Great Artesian Basin, and enormous floods reach it at intervals. Yet, though the lake has been encircled several times, no one has succeeded in reaching the main body of its waters, or in sounding its depths. In 1922, before the great drought set in, Hallighan, in an aerial survey of the lake, reported that while Lake Eyre South (area 460 square miles at 40 feet below sea-level) was almost dry, there were over 1000 square miles of water in the northern lake. Since then no water has apparently flowed into the lake, but whether it is "bone dry," as is maintained by Mr. C. T. Madigan, leader of the Central Australian Aerial Survey which flew over the lake in July, remains to be proved. Dr. Woolnough, the only geologist who has yet studied the lake-beds in detail on the ground, states that all the major lakes are filled with foul black mud to a great depth. Mr. Upton, however, only found this to be the case in Lake Torrens opposite the mouths of creeks. The lake-bed as a whole was covered by a thin dry sandy-salt crust under which the bed was damp, but it was possible to walk out a mile or more only sinking in a few inches. At the same time near the mouth of the channel to Spencer Gulf he found a large pool of water covered with a thick white scum which would make it invisible from the air. He therefore maintains that there is still danger to man, beast, or aeroplane landing on the crust of a "lake-pie." It is stated that on December 5 Mr. Madigan intends to start on a further aerial reconnaissance to examine the bed of Lake Eyre with a view to its commercial possibilities.

AN UNUSUAL FORM OF CAVE-ICE

A remarkable type of ice-formation in caves, which has attracted little attention on account of its somewhat rare occurrence, is described by Prof. George Kyrle in the *Mitteilungen* of the Vienna Geographical Society, Nr. 1–4, 1929, from observations made last winter in the Lur cave between Peggau and Semriach. The rarity of the phenomenon is ascribed to the rather special meteorological conditions necessary to the formation of what have been termed ice-clubs, slender shafts of ice rising from the floor of a cave with a club-like enlargement at the top. Like stalactites and stalagmites they are caused by the dripping of water from the roof of the cave, but a decidedly low temperature, such as was experienced last winter, seems to be a requisite. (The only previous description of ice-clubs is stated to have been in a paper by Berr and Hassinger in the *Zeitschrift* of the

German and Austrian Alpine Club in 1902.) In the Lur cave they were found in the vicinity of both the entrances, where ice-formation is rarely observed, and near the upper entrance about 100–150 were to be seen, rising from the steeply sloping debris at the side of the cave, and up to some 5 feet in height. A remarkable fact, which helps to explain the mode of formation, is that while the shafts are of milky-white ice, the heads or other enlargements are clear and transparent. This indicates that the shafts must be formed under a very low temperature, the dropping water freezing instantly without leaving time for the included air to escape. The heads are formed when the temperature is higher, permitting both the escape of air and the spreading out of the water before actually freezing. The fact that no icicles were found hanging from the roof is ascribed to the statical meteorological conditions, under which there was an indraught of very cold air along the floor of the cave, and an outflow of air, warmed by contact with the rock-surface, above. An excellent photograph of a group of ice-clubs accompanies the paper.

DISTRIBUTION OF MAXIMUM AND MINIMUM TEMPERATURES OVER THE GLOBE

In M.O. *Geophysical Memoir* No. 44 Dr. C. E. P. Brooks produces two maps of the world showing the distribution of the average annual maxima and minima of air temperature, that is to say, the average extreme range of the thermometer in the course of a year. The study is based on some five hundred stations figuring in the *Réseau Mondials* for the period 1910 to 1921. Of the isotherms showing average annual maxima that of 100° F. embraces large areas in Africa, Southern Asia, Australia, and South America, with a small area in the United States, and that of 110° is also conspicuous in Africa, Asia, and Australia, whilst in the Sahara, the Persian Gulf, and North-West India the temperature must be expected every year to reach 120°. In Europe large areas lie within the 90° isotherm, whilst South-East England is within the 80° line. Of the isotherms of minimum temperatures, the −70° appears in Siberia, and the −60° in Canada. Over the equatorial belt the temperature does not usually fall below 70° F., but in South Africa the Sahara and Central Australia it must be expected to drop to 30°.

One criticism that may be made is that unless the student realizes that these maps are only very rough, the scale being extremely small, he will be misled, particularly with regard to the distribution of the minimum temperature, which is more irregular and more susceptible to influences of local configuration than that of the maximum. Thus, on the basis of only three British stations, namely Greenwich, Aberdeen, and Valentia, the isotherm of 20° F. is drawn down the east coast of Great Britain. In reality it ought to be drawn considerably farther west, since the hardest night frosts occur in the interior of the country—not infrequently in deep mountain valleys in the western districts —a classic example being Ross-on-Wye, which, though lying on a higher winter isotherm than the London district, experiences as a rule much lower extreme minima on account of local configuration. Nevertheless, it is difficult to see how large-scale isotherms of this character would be drawn at all across rugged regions like the Central Highlands of Scotland, to say nothing of high mountain regions; for the minima, already stated, tend to occur in hollows rather than on the summits, and there is no nominal correction that can be applied to reduce the stations approximately to some standard level as is used in the case of the more general isotherms. The figures used for the production of these maps have been deliberately left uncorrected for altitude, since it has been found that no regular relation to height exists as in the case of mean temperature.

MEETINGS: SESSION 1929–1930

First Evening Meeting, 4 November 1929. The President in the Chair

Paper: River Exploration in Labrador by Canoe and Dog Sledge. By Mr. H. G. Watkins

First Afternoon Meeting, 11 November 1929. The President in the Chair

Paper: The Arundel Method of Stereographic Survey. By Captain M. Hotine, R.E.

Second Evening Meeting, 18 November 1929. The President in the Chair

Elections: Capt. A. H. A. Alban, D.F.C.; Horace Amon. B.A.; Richard John Anwyl; Edgar Ritson Ashley; Leigh Ashton; Leo Austen; The Hon. Lady Bailey; James Benjamin Volant Baker, M.A.; William Edward Barrett; Alexander Andrew Belford; Dr. Anita Uarda Maris Boggs, A.M.; Evan Boyd-Morrison; William Arthur Bright, B.A.; Donald Adams Cadzow; Richard Gardiner Casey, D.S.O., M.C., M.A.; Capt. William Robert Chaplin; The Lady Chaytor; Herbert Victor Clark; Roy Hurn Close; Percival John Hale Coke; David Cunninghame Cuthbertson; Robert Vernon Savil d'Arcy-Hildyard; Thomas W. Davies; Lt.-Col. Alfred Delme-Radcliffe, D.S.O.; Percy Dent; Arthur Diamond, M.D., J.P.; John Home Dickson, B.Sc.; William Langdon Dix; J. H. Dugard, B.Sc.; Capt. Robert Tait Duthie; Percy Thomas Dyer, M.M.; Capt. Brian Egerton, R.N.; Mrs. Eileen Elgar; Wilfred Evans; Brigadier William Henry Evans, C.I.E., D.S.O., R.E.; Edward Evan Evans-Pritchard, M.A., PH.D.; Muhammad Fahim Bey; Miss Beatrice France, B.A.; Major James Edward Evans Galbraith, D.S.O.; Michael Gallia; Sir Alexander Gibb, G.B.E., C.B., M.INST.C.E.; Miss Florence Emmeline Phillipa Gillett; Edward John Gittins; The Rev. H. K. Gordon, M.A.; Walton L. Grace; C. J. A. Gregg; Lt-Col. H. Hallilay, I.M.S.; Richard Todd Hancock; George Cooper Hatton; John Nairn Hay, M.B., CH.B.; Herbert Henry Hilscher, B.B.A.; Arthur John Hopkinson, I.C.S.; Josephus Theophilus John; Miss Anna M. Jones, M.Sc.; Miss Charity Leonora Kellett, B.A., B.Sc.; Mrs. Elizabeth Healy Kerr; Capt. Walter Basten Kerr; Ee Yew Kim, F.R.ECON.S.; C. E. Langton; Major W. L. Melville Lee; The Rev. G. Reginald Lindsay, M.A.; The Rev. Herbert Lindsay; Kenneth Lindsay, M.B., CH.B., M.A.; Miss Helen Lloyd; Ba Lwin; Miss Frederica Gladys MacIver; Alan John Grange Mackay, M.B., B.S., F.R.C.S.E., D.R.; George Patton Mackenzie; Lt.-Col. P. J. Mackesy, D.S.O., M.C.; John M. MacKinnon; John McLorn; Allan McNab; Lt.-Col. H. G. Martin, D.S.O., O.B.E.; Joseph Meek; Robert Morf; Brian James Acheson Neil, M.A., B.Sc.; Stanley Nelson; Prof. Tetsuji Ono; Thomas Edward Parker; John Duncan Patterson; Capt. F. E. Payne, R.E.; Robert P. Pflieger; Mrs. J. Whitaker Priestley; John Boswell Rapp; Alexander Lewis Raven; Kenneth Alfred Ray, B.A.; Abdul Rahim Riyaz, B.A., B.T.; Mrs. May H. Roberts; Walter Harrison Scott; Eric Shepherd; Capt. P. G. Shilston, R.D., R.N.R.; Albert Simmons; Capt. Malcolm Cecil Sinclair, I.A.; Norman St. Barbe Sladen, F.R.E.S.; Harry Peace Smith, B.A.; James Ramsay Smith; Mrs. Yolande Stansfeld; Col. R. H. Stapleton-Cotton; Nathan Comfort Starr, M.A., PH.D.; Cuthbert Henry Stringer, M.A.; The Ven. Archdeacon George Ruthven Thornton; Sub-Lieut. Richard Gibson Tosswill, R.N.; H. H. Von der Osten; Major-Gen. George Walker, C.B., C.B.E., D.S.O.; Robert Stuart Warner; C. W. Wavell; Major A. D. Whatman; George Cornelius Wilkins; William Cyril Williams; James Williamson; Leslie Robert Wood, B.Sc.; Henry Newcome Wright, LL.D.; James Wolstan Young

Paper: The Colour of Ruwenzori. By Mr. Carveth Wells.

NOTICES

ROYAL GEOGRAPHICAL SOCIETY: BUILDING FUND

The building makes good progress: the walls of the Hall are about fifteen feet above ground, the new Map Room is well advanced, and the Council Room corridor above the Entrances and Cloak Rooms. The connections with the original house are now being made, and the various departments temporarily removed from some of their rooms for the construction of the new lift.

The Fund does not progress so fast as the Building. On November 25 the total to date was £14,953, so that about £5000 is still wanted to complete the building.

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ROYAL GEOGRAPHICAL SOCIETY: NOTICES

EVENING MEETINGS IN THE AEOLIAN HALL

Monday December 2 *at* 8.30 *p.m.*
THE CENTRAL AFRICAN HIGHWAY. *By Mr. Owen Tweedy*

Monday December 16 *at* 8.30 *p.m.*
FURTHER WORK ON THE GREAT BARRIER REEFS. *By Mr. M. A. Spender*

Monday January 13 *at* 8.30 *p.m.*
FORESTS AND PLANTS OF THE ANGLO-EGYPTIAN SUDAN. *By Dr. T. T. Chipp*

Monday January 27 *at* 8.30 *p.m.*
THE CAMBRIDGE EAST GREENLAND EXPEDITION, 1929: ASCENT OF PETERMANN PEAK. *By Mr. J. M. Wordie*

There will be no Afternoon Meeting on December 9

CHRISTMAS LECTURES FOR YOUNG PEOPLE IN THE AEOLIAN HALL

Monday January 6 *at* 3.30 *p.m.*
PLACES SEEN FROM THE AIR. *By Major C. K. Cochran-Patrick, D.S.O.*

Friday January 10 *at* 3.30 *p.m.*
BY CANOE AND DOG SLEDGE IN LABRADOR. *By Mr. H. G. Watkins*

Admission by special tickets, for which application should be made to the Chief Clerk by letter delivered not later than the first post of January 1.

THE SOCIETY'S HOUSE

Owing to the alterations at the east end of the old building required to connect with the new, the Working Library, Staff, and Catalogues are temporarily removed to the Reading Room; the New Books and Journals from the Reading Room are removed to the Fellows' Library; and the offices of the Librarian and Assistant Librarian are removed to the Tea Room, which is temporarily closed; but tea will be served as usual in the two Smoking Rooms.

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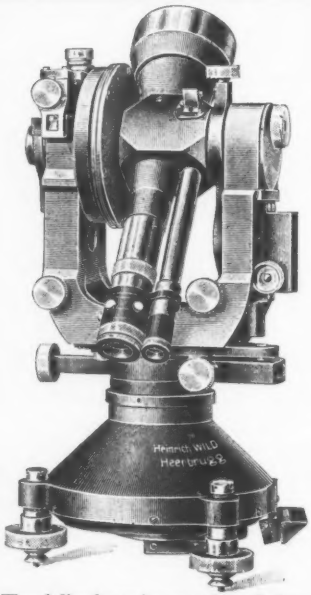

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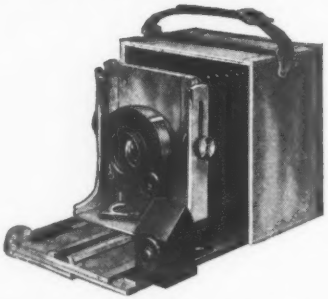

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